Welwyn Resistors

20 Sept, 1947.

WELWYN ELECTRICAL LABORATORIES LIMITED

TECHNICAL DATA
FOR
WELWYN RESISTORS

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CONTENTS

	Page
Introduction	1
Section I. Fixed Wire Wound Vitreous Enamelled Resistors—	
Pattern AW—Miniature, self supporting axial Leads ..	3
,, AW—Self supporting, axial leads..	5
,, AW— ,, ,, radial leads..	7
,, AP —Flexible copper terminals—	
Mark III Range	9
,, IV ,, ...	11
,, B —Narrow terminal bands—	
Mark III Range	13
,, IV ,, ...	15
,, C —Clip mounting—	
Mark III Range	17
,, IV ,, ...	19
Clip Mounting Details	21
Non-Inductive Resistors	22
Inter-Services Preferred Sizes	23
Illustrations of Special Patterns	24
Section II. Fixed Wire Wound Lacquered Resistors	25
Section III. High Stability Carbon Resistors	27
SECTION IV. APPENDIX	

INTRODUCTION

FIXED WIRE WOUND VITREOUS ENAMELLED RESISTORS.

The " Welwyn " Vitreous Resistor consists essentially of a nickel chrome Resistance wire wound on a ceramic former and covered with a protective enamel.

The resistance wire used is the purest obtainable.

A heavy gauge wire is used as the end connection for the resistance winding in order to reduce the current density and, consequently, the heating to a minimum. The end connection is thus reliable in service. The end connections are also of nickel chrome and are fused with the resistance wire at very high temperature, special methods being used which do not involve the introduction of materials other than those of which the wire and end connections are made. By this means the weakness associated with resistors in which the end connection is made by mechanical pressure or by hard soldering is eliminated.

The high quality of the special " Welwyn " enamel and the careful and robust construction are features of superiority in " Welwyn " Resistors. The enamel is impervious to attack by atmospheric agents or by the common acids or alkalies. It is soluble to a slight extent in hydrofluoric acid. The enamel is extremely hard and perfectly non-porous. It is vitrified on the resistor under carefully regulated conditions which yield a product perfectly uniform and absolutely free from cracks. The composition of the enamel is such as to exclude, even at a very high temperature, any possibility of chemical or electro-chemical action between the nickel chrome wire and the enamel. The resistor can, consequently, be operated at very high temperatures without slow corrosion of the wire by the enamel and consequent progressive increase of ohmic value. Its life even under adverse conditions is extremely long.

Resistance Tolerance.

Resistors are normally supplied to a resistance tolerance of ± 5%, but closer limits can be supplied upon request.

The dimensions shewn in the catalogue are nominal.

Tolerance in length : Pattern AW ± 1/16 in. Pattern AP ± 1/16 in.
Pattern B ± 1/16 in. Pattern C + 1/16 in.—1/8 in.

Tappings.

All types (except AW.3101 and AW.3115) can be supplied with tappings. The special methods used in the making of the end connection joints are also used in the intermediate connections, so that the reliability of the plain resistor is maintained in the tapped type.

The provision of tappings reduces the rating to some extent. The percentage reduction will depend on the resistor size and the number of tappings. Detailed information will be furnished on request.

Special Resistors.

A few examples of special purpose resistors are illustrated on Page 22. These indicate the variety of termination which can be obtained if required.

Resistors of low inductance or low distributed capacity can be supplied on request.

Resistance values outside the range quoted in the catalogue will receive special consideration. Values down to 0·1 ohm and up to 0·25 megohms can be supplied to special order.

Marking on Resistors.

On each resistor the name "Welwyn," the type number and the nominal resistance value are clearly and indelibly marked.

Suggestions for the Choice of " Welwyn " Vitreous Resistors.

" Welwyn " Vitreous Resistors will run normally at 400°C., but other factors may govern the permissible temperature rise. The selection of the type and dimensions of a resistor necessary to dissipate a given power should first be made on the basis of the permissible operating temperature, by reference to the load-temperature curves in the following pages. Due allowance may then have to be made for the possible over-loads or surges which the resistor may have to sustain. These curves indicate the maximum surface temperature when the resistor is mounted vertically in free air at 20°C., the bore being unobstructed to allow for free circulation of air.

It should also be taken into account that the maximum continuous watts shewn in the tables are reduced for very low or very high values ; the maximum permissible volts between terminals limiting the rating in the latter case. Reference should also be made, therefore, to the load-resistance curves.

When a constant load is applied, " Welwyn " Resistors attain constant temperature after a period of approximately seven minutes.

All resistors are given a full load test before leaving the factory.

Fixed Wire Wound Lacquered Resistors.

Welwyn wire wound lacquered resistors are wound with wire of nickel chrome or other alloys on a non-porous ceramic former and covered with sufficient coats of special lacquer to provide mechanical protection and inter-turn electrical insulation for the winding.

The temperature rise at the hottest point, when these resistors are run at the nominal rating indicated in the catalogue, is 60°C. which is permissible when resistors are operating in the tropics in ambient temperatures up to 60°C. Higher loading is permissible in lower ambient, providing the surface temperature does not exceed 120°C. (See temperature-load curves.)

The normal resistance tolerance is ± 5%. Resistors with closer tolerance will be supplied on request.

In addition to the standard range illustrated in this catalogue, we can supply on request resistors of other types and dimensions.

High Stability Carbon Resistors.

The Welwyn high stability carbon resistor is made by depositing a carbon film on to a high quality porcelain rod. Robust terminal caps are fitted in such a way as to provide excellent electrical continuity between the carbon film and the external tinned copper terminal wires. The resistance element is protected by means of a tropical lacquer which resists the effects of heat and moisture and withstands normal handling during assembly.

This resistor meets the need of modern communications equipment for a resistor of exceptional stability and low temperature co-efficient. These important features are tabulated in the catalogue. The stability is 2% over the whole range and is defined as the maximum percentage change of resistance which the resistor is liable to undergo during the course of its life in service under tropical or equally adverse conditions. When used under temperate conditions, the stability is very much improved.

GENERAL.

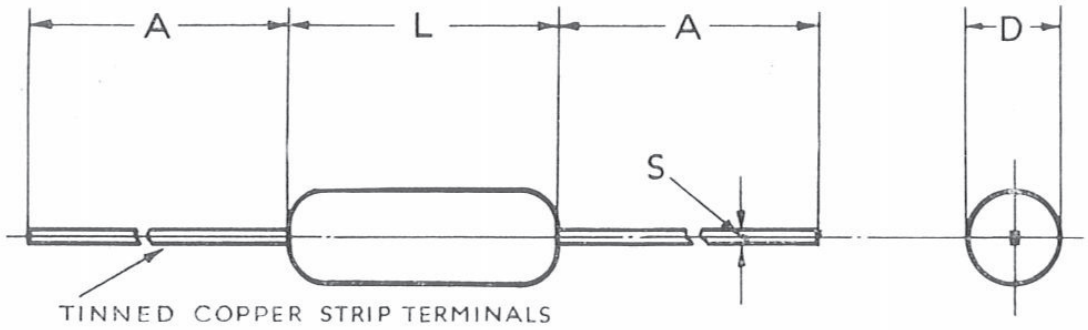
Enquiries for resistor types other than those shewn in our catalogue will receive our earnest attention.

SECTION I

WELWYN WIRE WOUND VITREOUS ENAMELLED RESISTORS

MINIATURE TYPE.

PATENT APPLIED FOR.



Type	*Max. Power. Continuous Watts (Wm.)*	*Ohmic Value*		*Dimensions in Inches*				*Maximum Continuous Voltage (Vm.)*
		Min.	*Max.*	D	L	A	S	
AW 3101	2	1	1K*	5/32	7/16	1-1/2	·03 × ·0124	50

The maximum permissible continuous load (Wm-watts) indicated above may be applied to resistors mounted in free air at a temperature of 20°C. When operating at maximum load under these conditions, the temperature on the enamelled surface is approximately 300°C.

At the higher resistance values (R-ohms), these ratings are limited by the maximum continuous voltage (Vm-volts) which may be applied between terminals and can be calculated from the formula $Wm = \frac{Vm^2}{R.}$

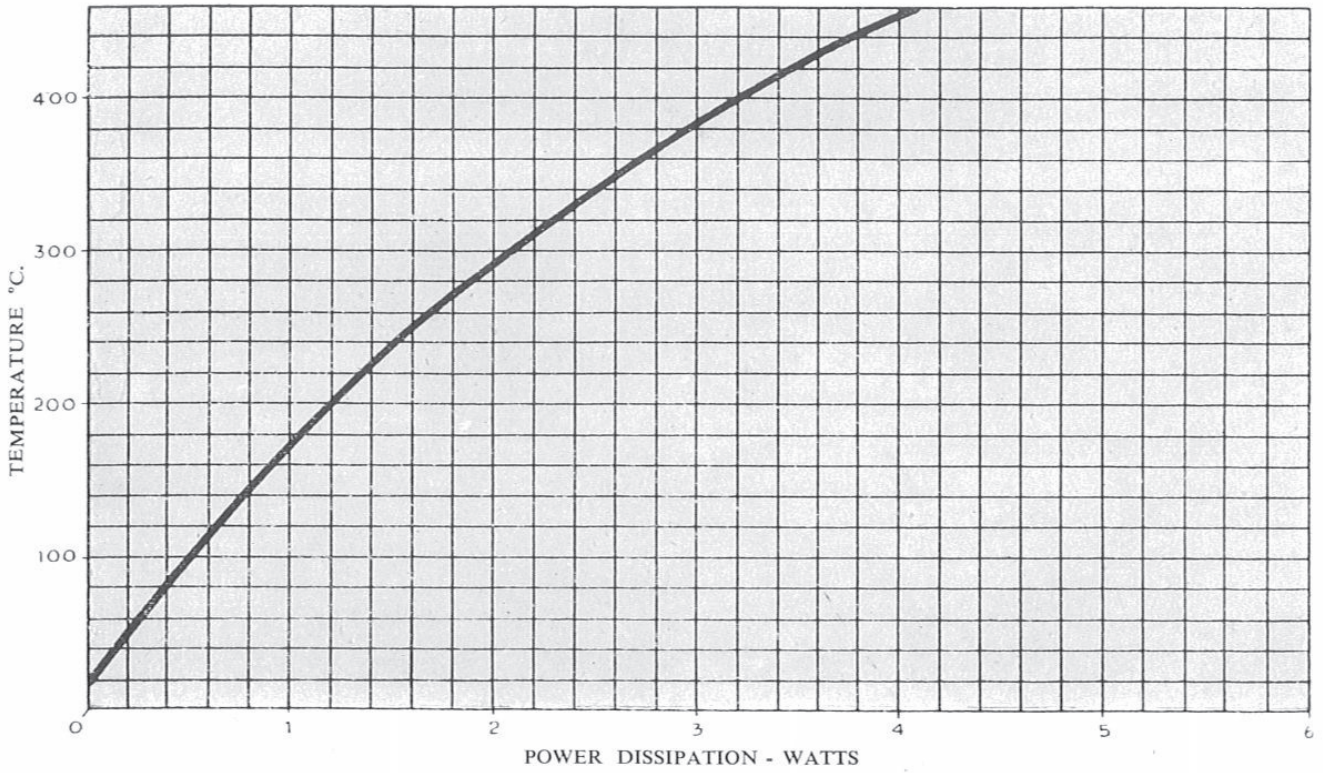
Surface temperatures for any given watts rating are illustrated by the graph overleaf.

Where the load is not continuous, the rating may safely exceed that indicated above. Our Technical Department will be pleased to indicate the extent to which over-loads may be applied for any given loading cycle.

* $K = 10^5$

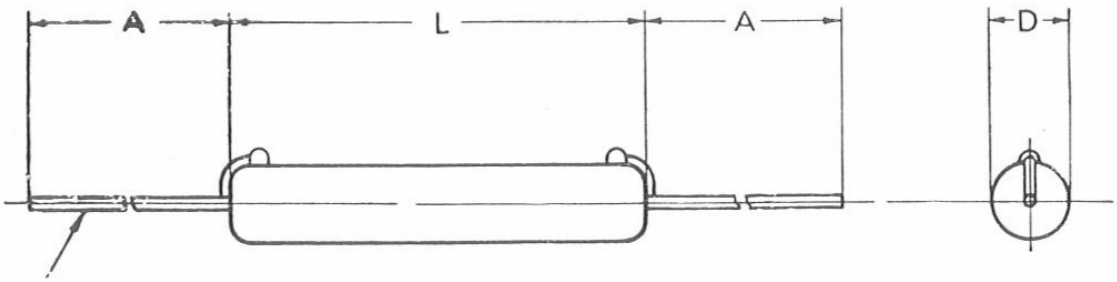
WELWYN VITREOUS RESISTORS

TEMPERATURE CURVE—TYPE AW 3101



VARIATION OF MAX. SURFACE TEMPERATURE WITH POWER DISSIPATION

PATTERN AW—AXIAL LEADS



TINNED COPPER TERMINALS, DIAMETER 'S.'

Type	*Max. Power. Continuous Watts (Wm.)*	*Ohmic Value*		*Dimensions in Inches*				*Maximum Continuous Voltage (Vm.)*
		Min.	*Max.*	D	L	A	S	
AW 3115	4	1	4K*	9/32	5/8	2	20 S.W.G.	100
AW 3111	6	3	15K*	9/32	1-3/8	2	20 S.W.G.	200
AW 3112	12	4	24K*	9/32	1-3/4	2	20 S.W.G.	300

The maximum permissible continuous load (Wm-watts) indicated above may be applied to resistors mounted vertically in free air at a temperature of 20°C. When operating at maximum load under these conditions, the temperature on the enamelled surface is approximately 400°C.

At the higher resistance values (R-ohms), these ratings are limited by the maximum continuous voltage (Vm-volts) which may be applied between terminals and can be calculated from the formula $Wm = \frac{Vm^2}{R.}$

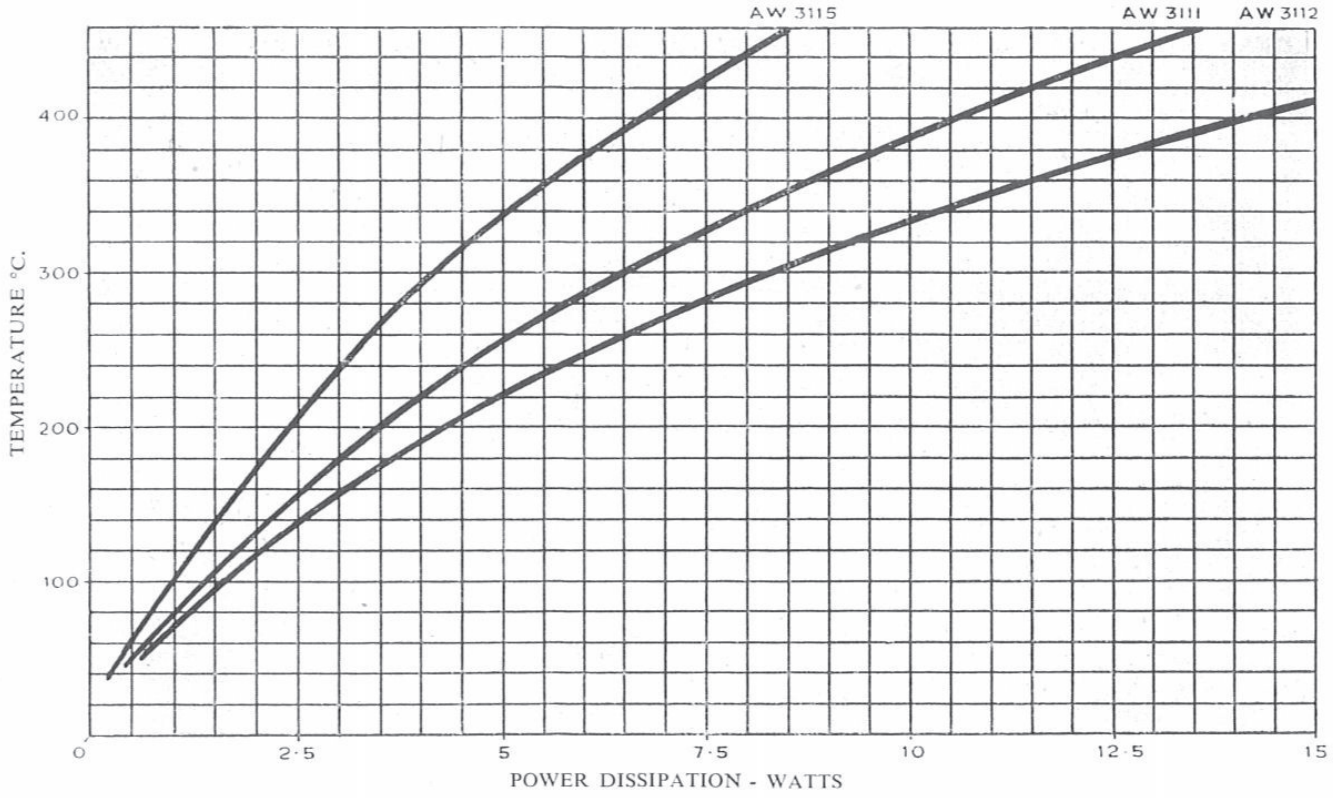
Surface temperatures for any given watts rating are illustrated by the graphs overleaf. Variation of maximum continuous load with resistance is also shewn.

Where the load is not continuous, the rating may safely exceed that indicated above. Our Technical Department will be pleased to indicate the extent to which over-loads may be applied for any given loading cycle.

* $K = 10^3$

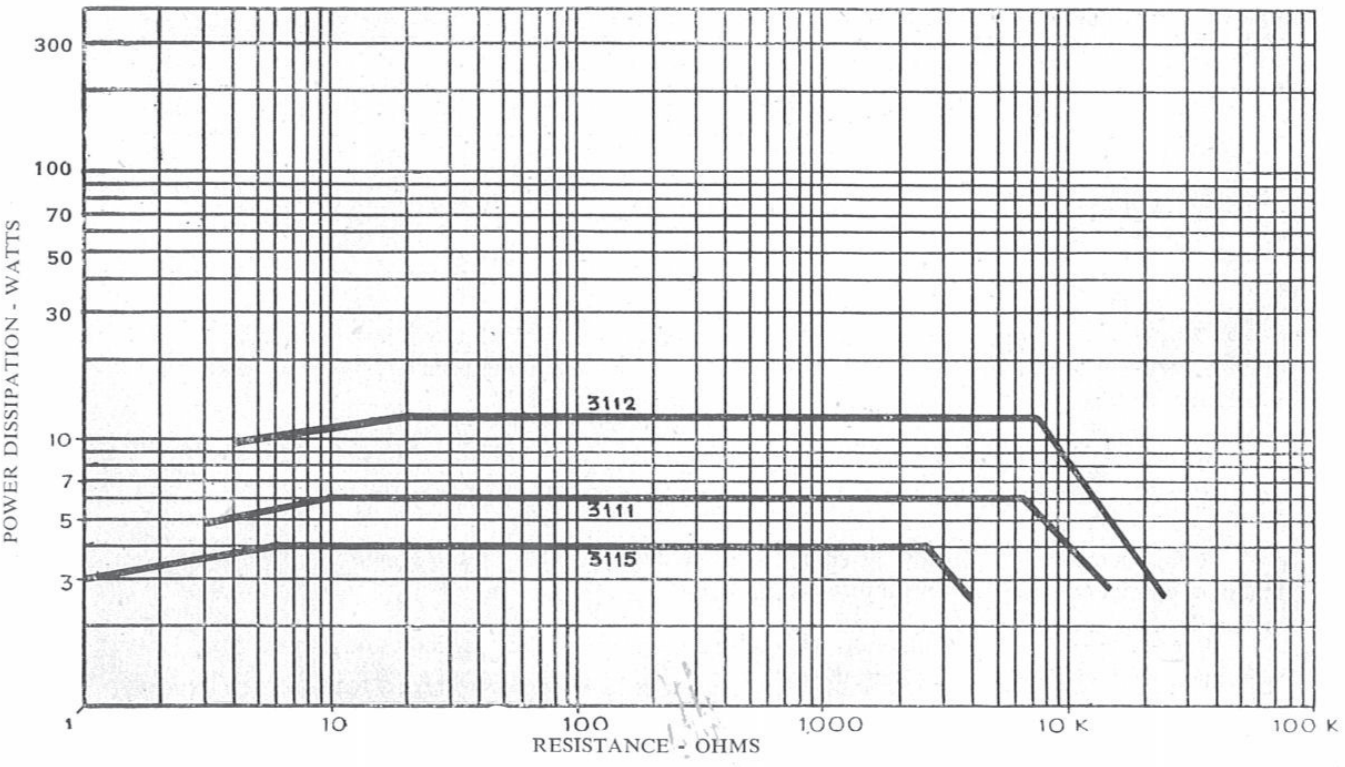
WELWYN VITREOUS RESISTORS

TEMPERATURE & LOAD CURVES—PATTERN AW



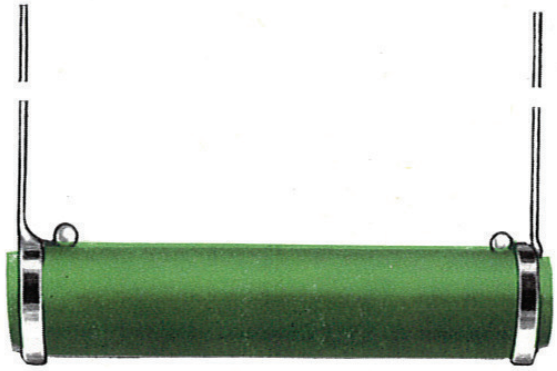
VARIATION OF MAX. SURFACE TEMPERATURE WITH POWER DISSIPATION

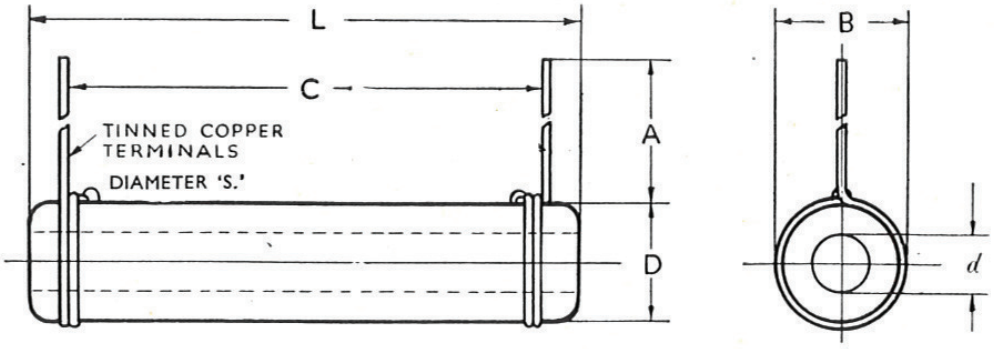
(RESISTORS VERTICAL IN FREE AIR AT 20°C.)



VARIATION OF POWER DISSIPATION WITH RESISTANCE

PATTERN AW—RADIAL LEADS





Type	*Max. Power. Continuous Watts (Wm.)*	*Ohmic Value*		*Dimensions in Inches*							*Maximum Continuous Voltage (Vm.)*
		Min.	*Max.*	d	D	L	A	B	C	S	
AW 3192	30	10	35K*	1/4	1/2	2-3/8	2	9/16	2-1/8	18 S.W.G.	550
AW 3123	30	6	25K*	5/16	5/8	2-1/8	2	11/16	1-7/8	18 S.W.G.	450
AW 3124	45	8	40K*	5/16	5/8	2-7/8	2	11/16	2-1/2	18 S.W.G.	700

The maximum permissible continuous load (Wm-watts) indicated above may be applied to resistors mounted vertically in free air at a temperature of 20°C. When operating at maximum load under these conditions, the temperature on the enamelled surface is approximately 400°C.

At the higher resistance values (R-ohms), these ratings are limited by the maximum continuous voltage (Vm-volts) which may be applied between terminals and can be calculated from the formula $Wm=\frac{Vm^2}{R.}$

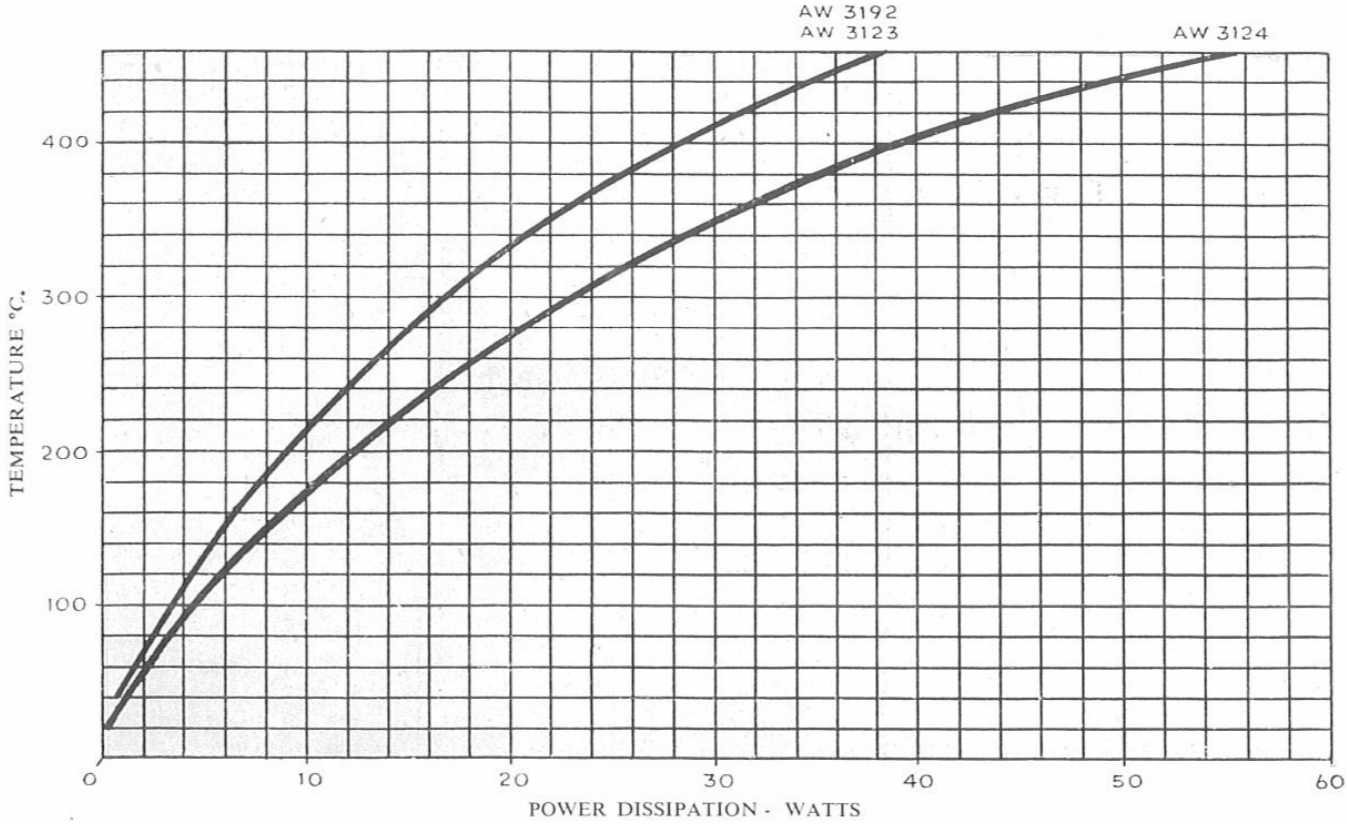
Surface temperatures for any given watts rating are illustrated by the graphs overleaf. Variation of maximum continuous load with resistance is also shewn.

Where the load is not continuous, the rating may safely exceed that indicated above. Our Technical Department will be pleased to indicate the extent to which over-loads may be applied for any given loading cycle.

* $K=10^3$

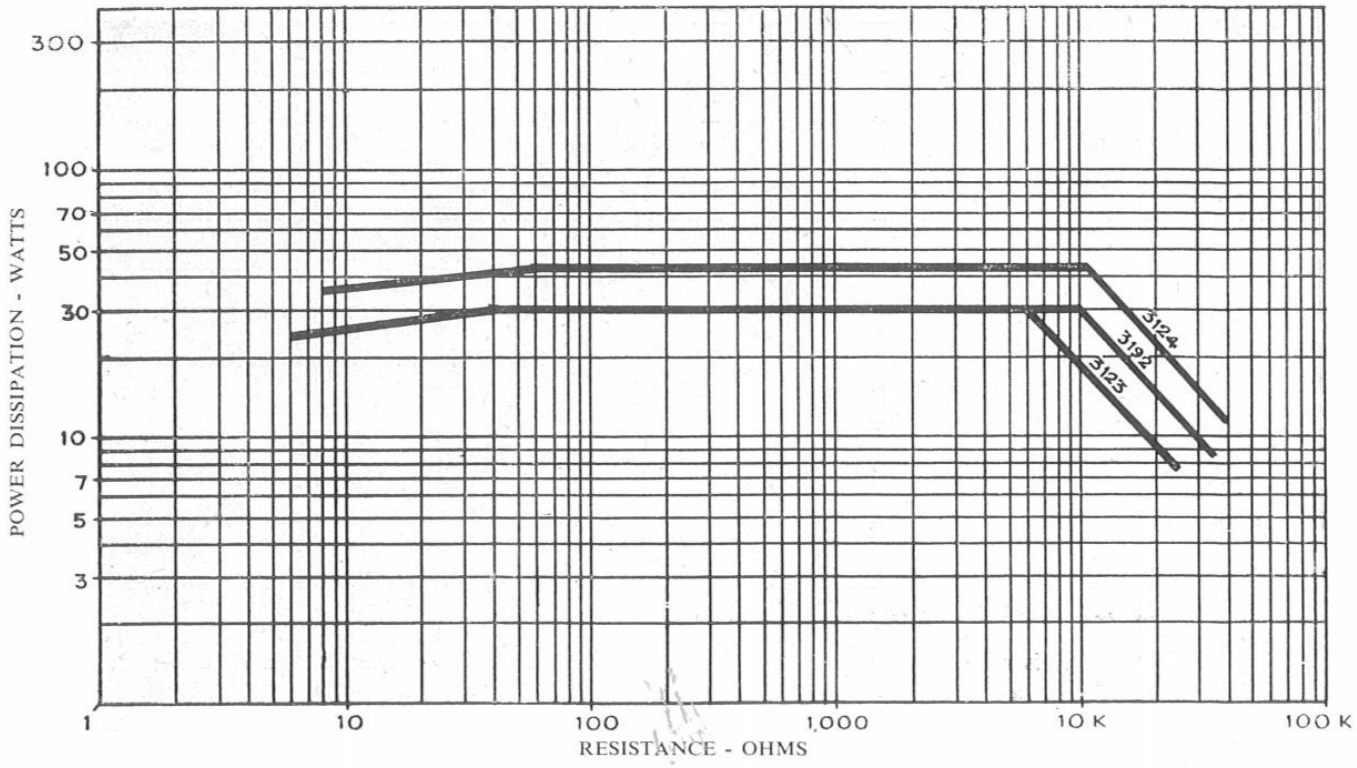
WELWYN VITREOUS RESISTORS

TEMPERATURE & LOAD CURVES—PATTERN AW



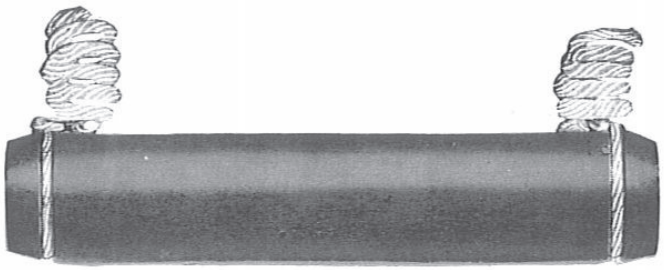
VARIATION OF MAX. SURFACE TEMPERATURE WITH POWER DISSIPATION

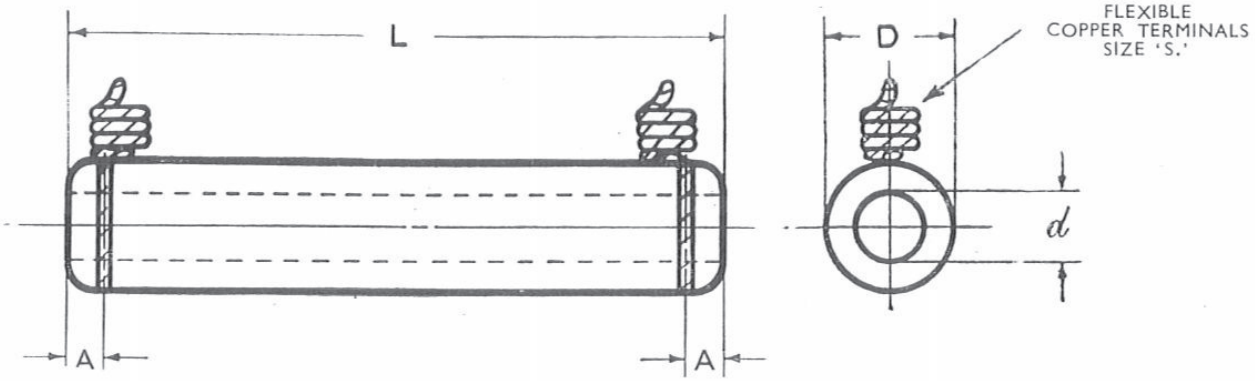
(RESISTORS VERTICAL IN FREE AIR AT 20°C., BORE UNOBSTRUCTED)



VARIATION OF POWER DISSIPATION WITH RESISTANCE

MARK III RANGE—PATTERN AP





Type	*Max. Power. Continuous Watts (Wm.)*	*Ohmic Value*		*Dimensions in Inches*					*Maximum Continuous Voltage (Vm.)*
		Min.	*Max.*	d	D	L	A	S	
AP 3123	30	6	25K	5/16	5/8	2-1/8	3/16	28/ ·0076	450
AP 3124	45	8	40K	5/16	5/8	2-7/8	3/16	28/ ·0076	700
AP 3125	65	10	60K	5/16	5/8	4	3/16	28/ ·0076	900
AP 3132	90	6	60K	3/8	7/8	4	3/8	46/ ·0076	900
AP 3141	115	6	80K	5/8	1-1/8	4	3/8	46/ ·0076	900
AP 3134	180	6	100K	3/8	7/8	6-1/2	3/8	46/ ·0076	1800
AP 3144	220	6	100K	5/8	1-1/8	6-1/2	3/8	46/ ·0076	1800
AP 3146	280	6	100K	5/8	1-1/8	8-1/2	3/8	46/ ·0076	2500

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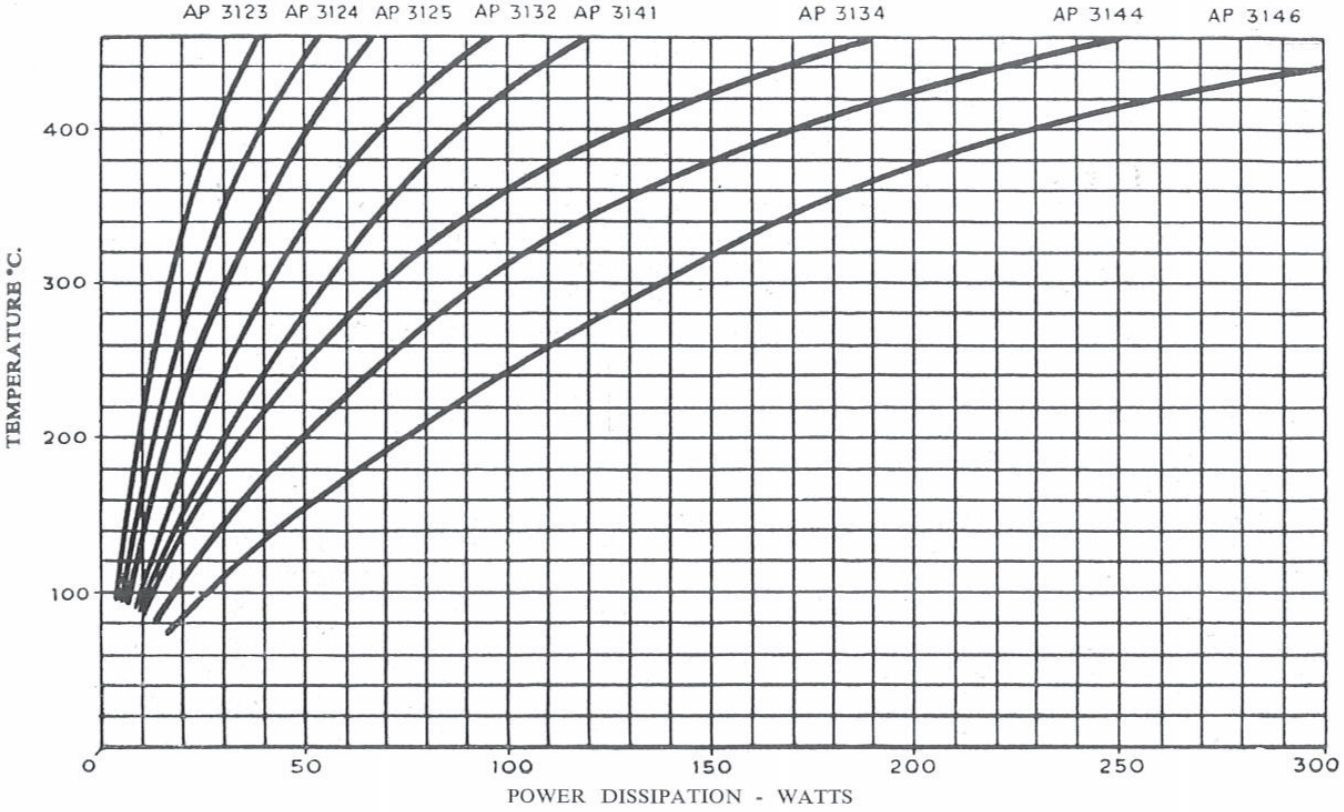
Methods of mounting will be gladly suggested on request.

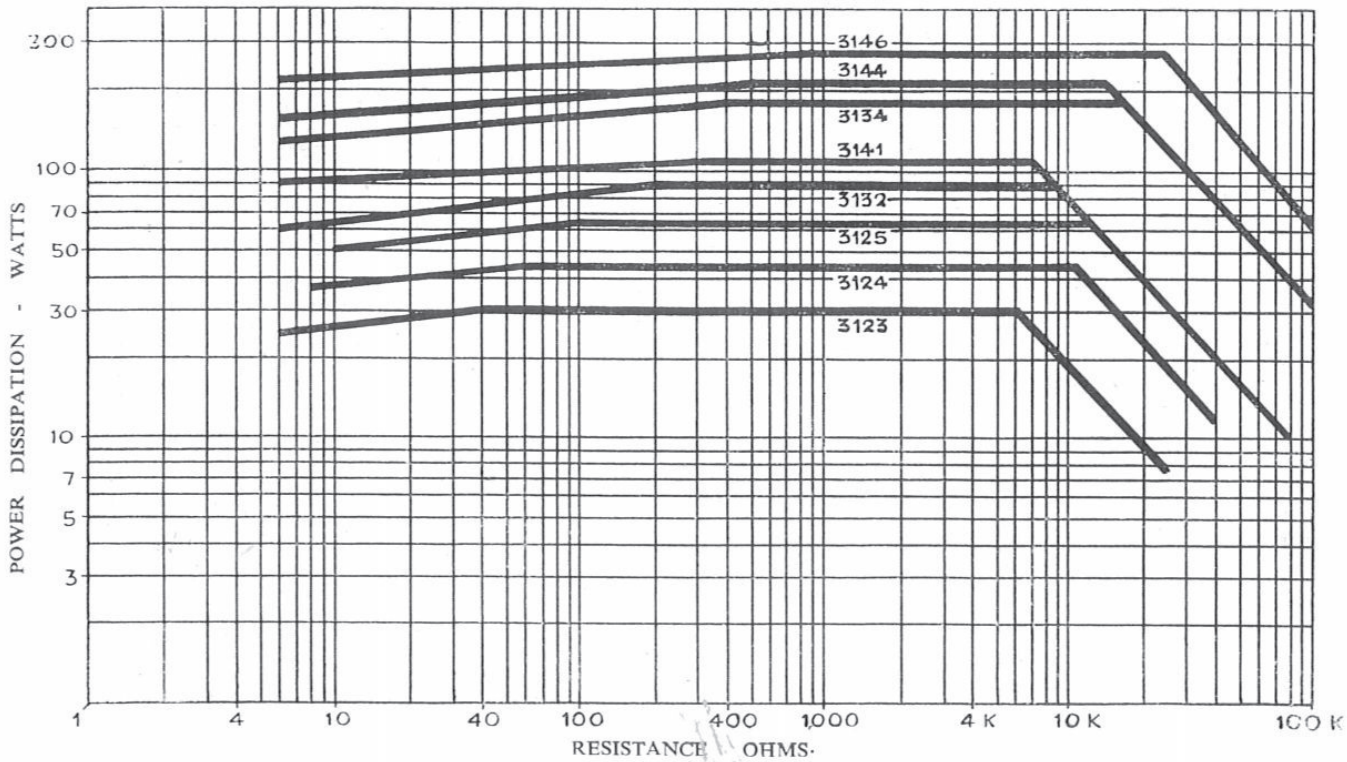
WELWYN VITREOUS RESISTORS

TEMPERATURE & LOAD CURVES—MARK III RANGE PATTERN AP



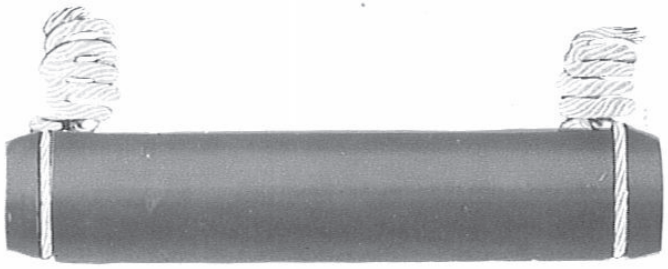
VARIATION OF MAX. SURFACE TEMPERATURE WITH POWER DISSIPATION

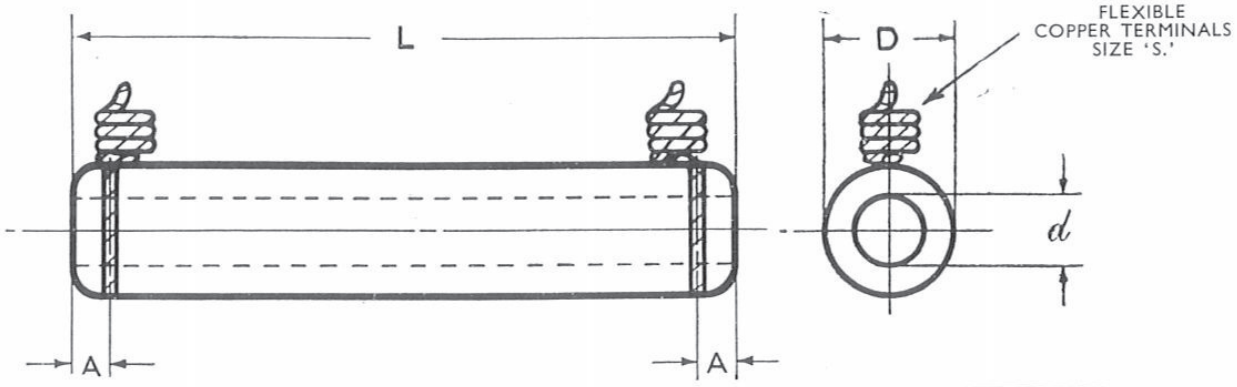
(RESISTORS VERTICAL IN FREE AIR AT 20°C., BORE UNOBSTRUCTED)



VARIATION OF POWER DISSIPATION WITH RESISTANCE

MARK IV RANGE—PATTERN AP





Type	*Max. Power. Continuous Watts (Wm.)*	*Ohmic Value*		*Dimensions in Inches*					*Maximum Continuous Voltage (Vm)*
		Min.	*Max.*	d	D	L	A	S	
AP 40	12	2	15K	5/16	5/8	1-5/16	3/16	28/·0076	200
AP 41	27	5	40K	5/16	5/8	2	3/16	28/·0076	400
AP 42	65	10	60K	5/16	5/8	4	3/16	28/·0076	900
AP 43	74	4	60K	3/8	7/8	3-1/2	3/8	46/·0076	700
AP 44	115	3	60K	5/8	1-1/8	4	3/8	46/·0076	900
AP 45	180	8	90K	3/8	7/8	6-1/2	3/8	46/·0076	1800
AP 46	200	5	100K	5/8	1-1/8	6	3/8	46/·0076	1800
AP 47	280	10	100K	5/8	1-1/8	8-1/2	3/8	46/·0076	2500

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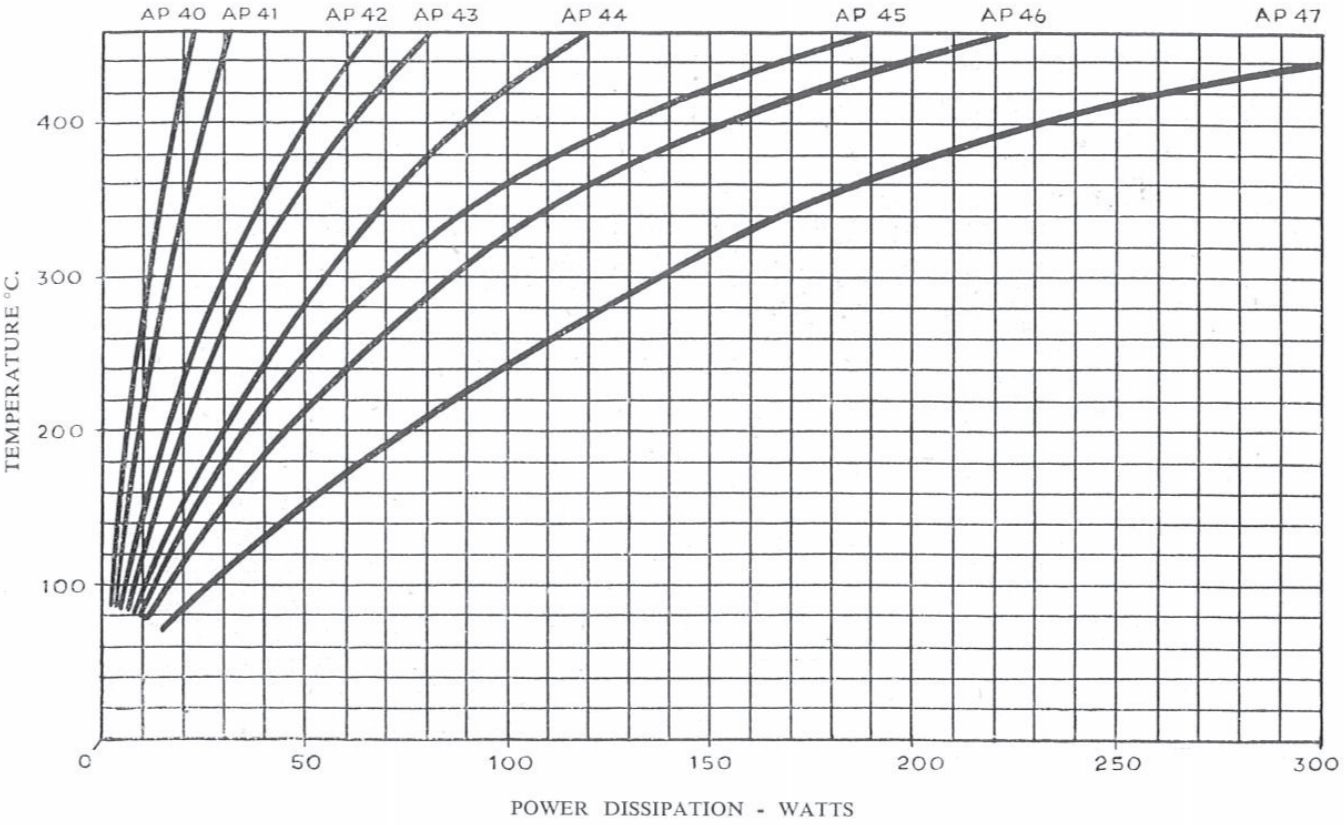
Methods of mounting will be gladly suggested on request.

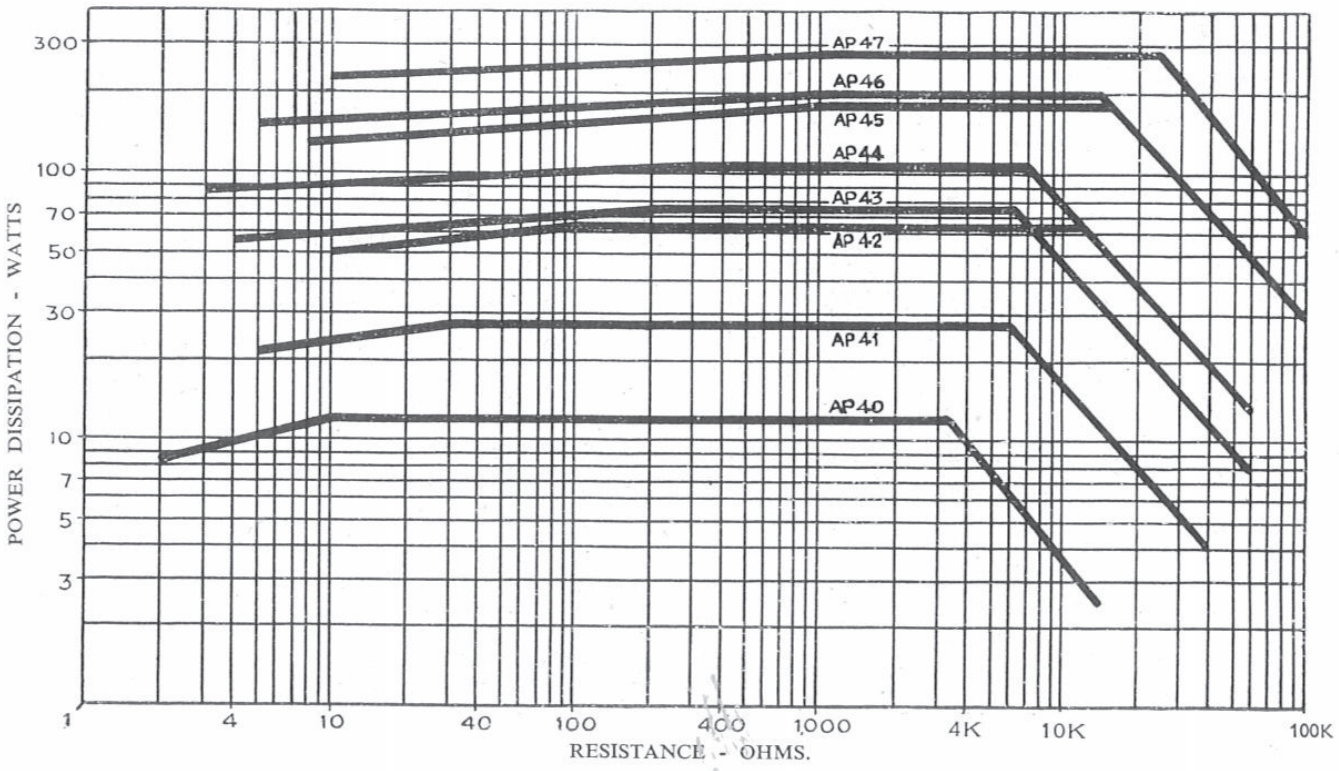
WELWYN VITREOUS RESISTORS

TEMPERATURE & LOAD CURVES—MARK IV RANGE PATTERN AP



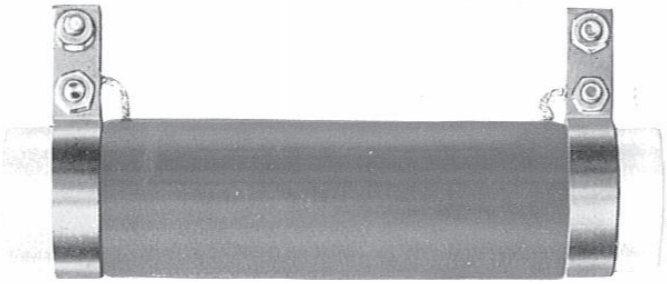
VARIATION OF MAX. SURFACE TEMPERATURE WITH POWER DISSIPATION

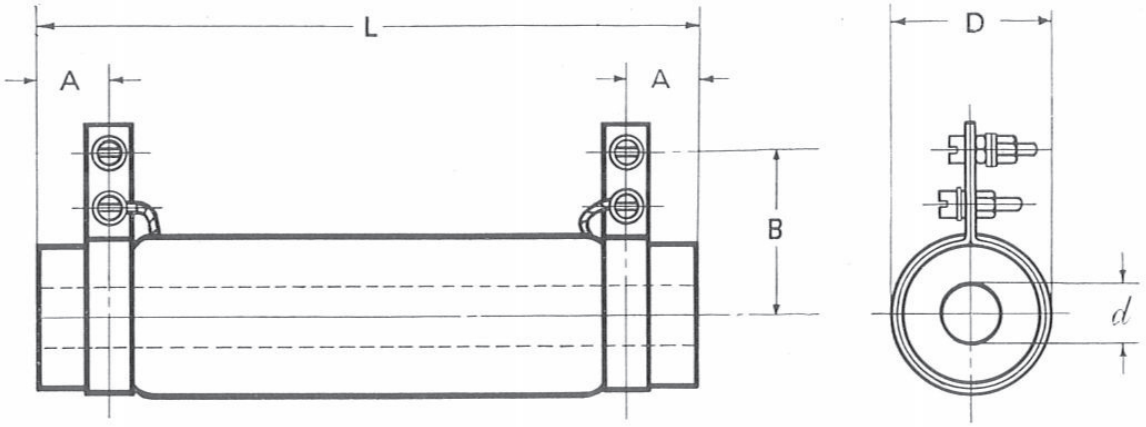
(RESISTORS VERTICAL IN FREE AIR AT 20°C., BORE UNOBSTRUCTED)



VARIATION OF POWER DISSIPATION WITH RESISTANCE

MARK III RANGE—PATTERN B





Type	*Max. Power. Continuous Watts (Wm.)*	*Ohmic Value*		*Dimensions in Inches*					*Maximum Continuous Voltage (Vm.)*
		Min.	*Max.*	d	D	L	A	B	
B 3123	30	6	25K	5/16	5/8	2-1/8	5/32	11/16	450
B 3124	45	8	40K	5/16	5/8	2-7/8	5/32	11/16	700
B 3125	65	10	60K	5/16	5/8	4	5/32	11/16	900
B 3132	90	6	60K	3/8	7/8	4	3/8	15/16	900
B 3141	115	6	80K	5/8	1-1/8	4	3/8	1- 1/8	900
B 3134	180	6	100K	3/8	7/8	6-1/2	3/8	15/16	1800
B 3144	220	6	100K	5/8	1-1/8	6-1/2	3/8	1- 1/8	1800
B 3146	280	6	100K	5/8	1-1/8	8-1/2	3/8	1- 1/8	2500

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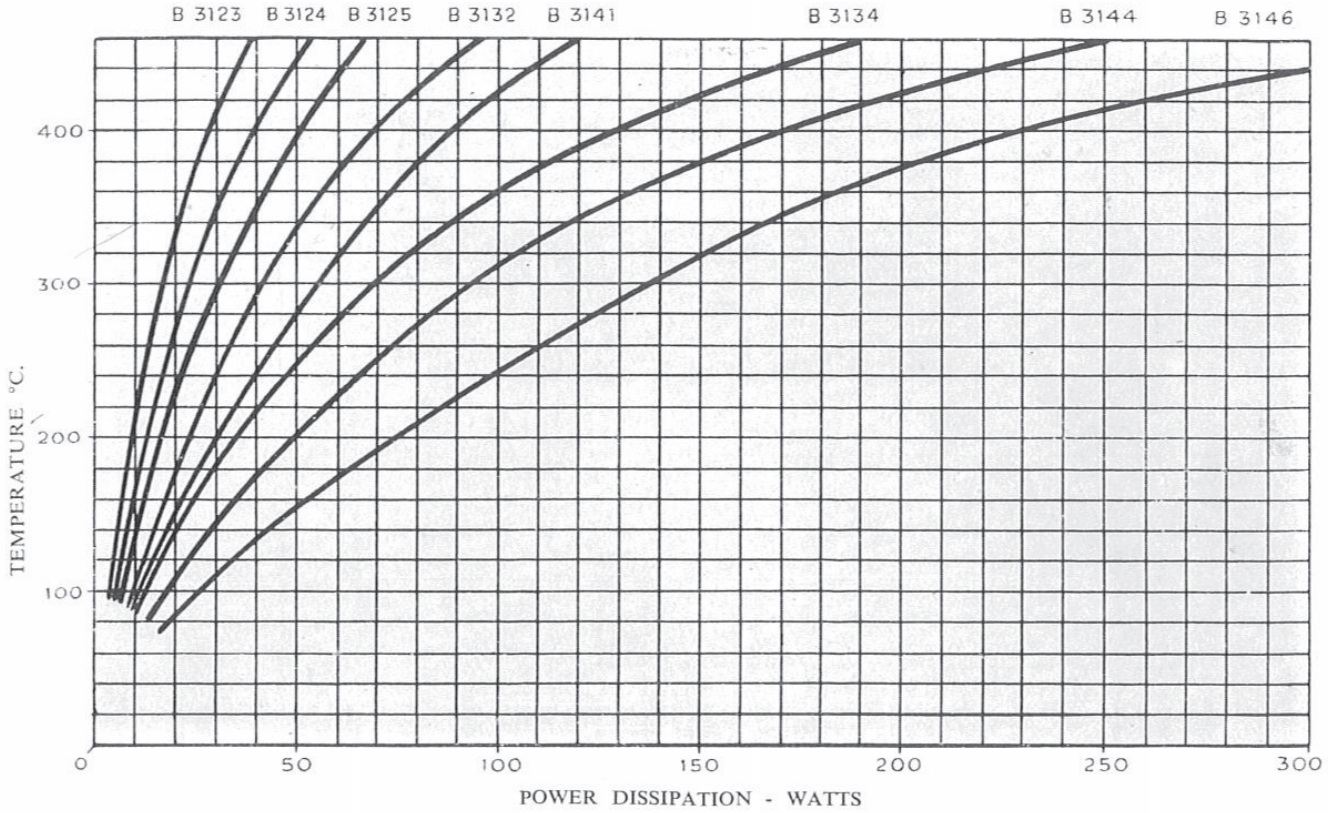
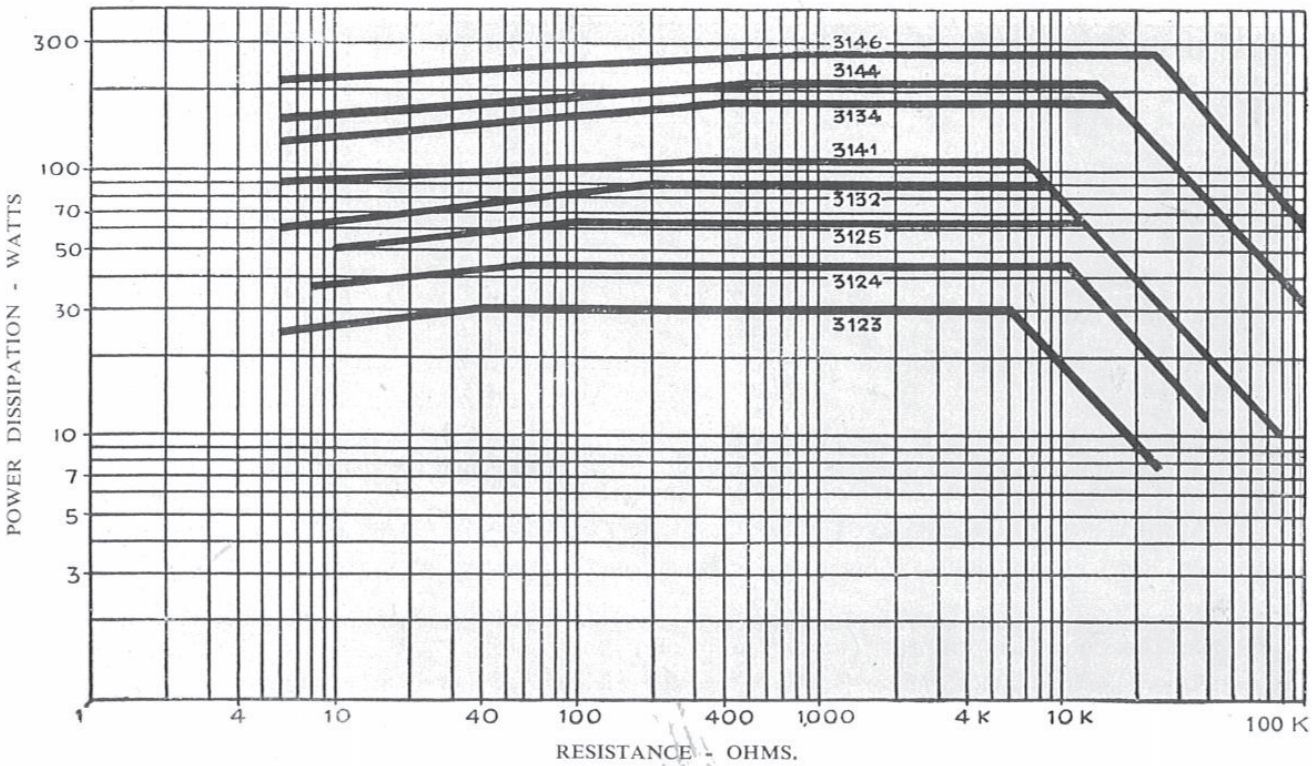
WELWYN VITREOUS RESISTORS

TEMPERATURE & LOAD CURVES—MARK III RANGE PATTERN B



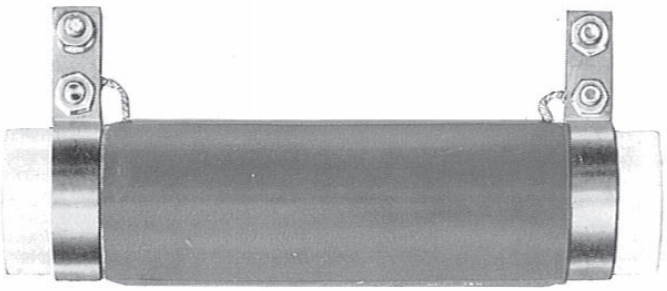
VARIATION OF MAX. SURFACE TEMPERATURE WITH POWER DISSIPATION

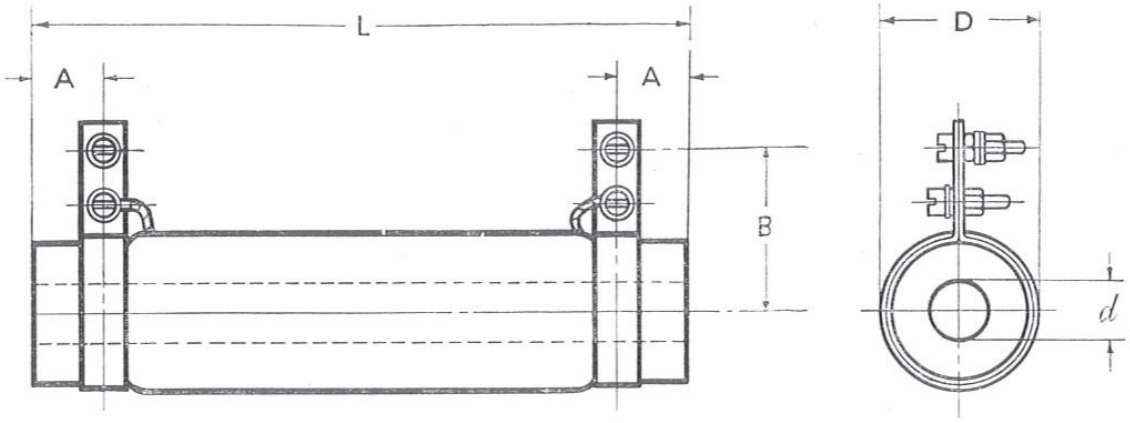
(RESISTORS VERTICAL IN FREE AIR AT 20°C., BORE UNOBSTRUCTED)



VARIATION OF POWER DISSIPATION WITH RESISTANCE

MARK IV RANGE—PATTERN B





Type	*Max. Power. Continuous Watts (Wm.)*	*Ohmic Value*		*Dimensions in Inches*					*Maximum Continuous Voltage (Vm.)*
		Min.	*Max.*	d	D	L	A	B	
B 40	12	2	15K	5/16	5/8	1-5/16	5/32	11/16	200
B 41	27	5	40K	5/16	5/8	2	5/32	11/16	400
B 42	65	10	60K	5/16	5/8	4	5/32	11/16	900
B 43	74	4	60K	3/8	7/8	3-1/2	3/8	15/16	700
B 44	115	3	60K	5/8	1-1/8	4	3/8	1- 1/8	900
B 45	180	8	90K	3/8	7/8	6-1/2	3/8	15/16	800
B 46	200	5	100K	5/8	1-1/8	6	3/8	1- 1/8	1800
B 47	280	10	100K	5/8	1-1/8	8-1/2	3/8	1- 1/8	2500

The maximum permissible continuous load (Wm watts) indicated above may be applied to resistors mounted vertically in free air at a temperature of 20°C. When operating at maximum load under these conditions, the temperature on the enamelled surface is approximately 400°C.

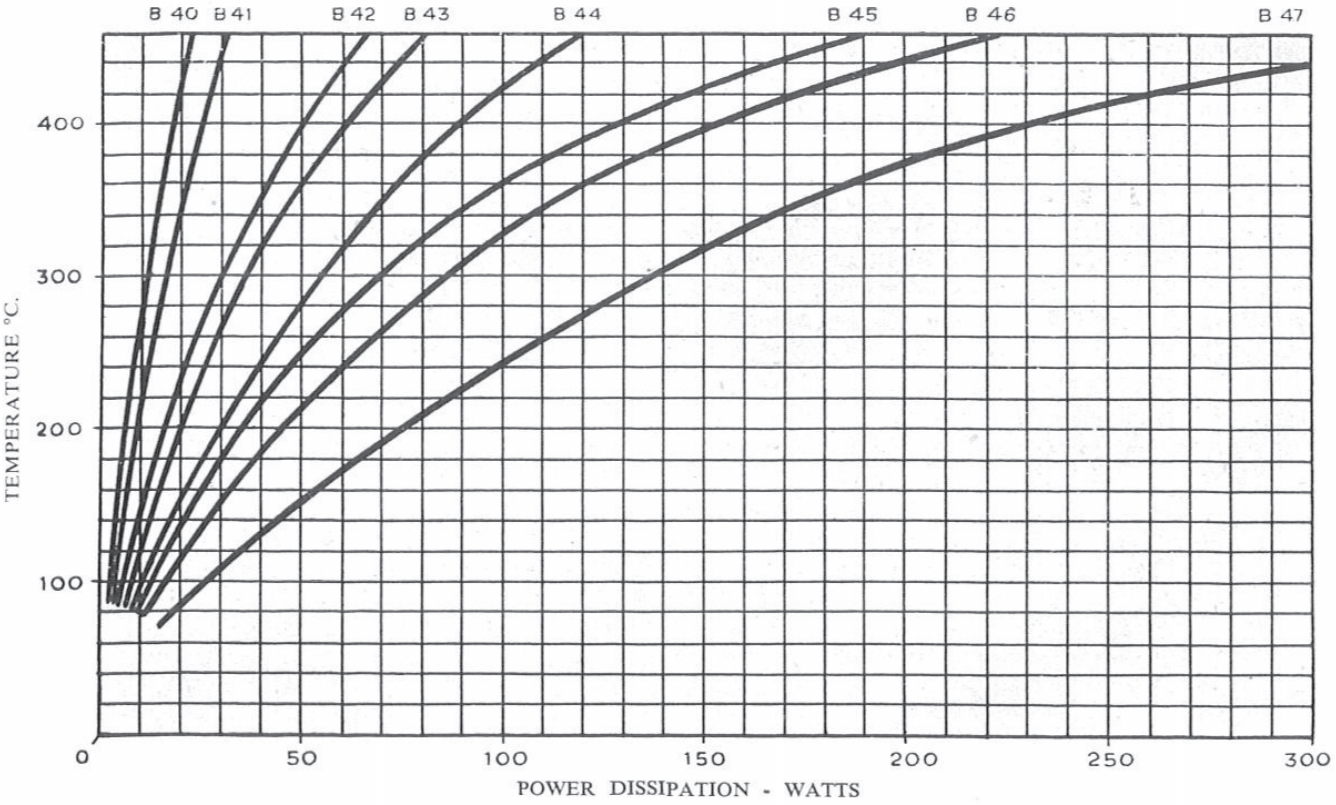
At the higher resistance values (R-ohms), these ratings are limited by the maximum continuous voltage (Vm-volts) which may be applied between terminals and can be calculated from the formula $Wm = \frac{Vm^2}{R.}$

Surface temperatures for any given watts rating are illustrated by the graphs overleaf. Variation of maximum continuous load with resistance is also shewn.

Where the load is not continuous, the rating may safely exceed that indicated above. Our Technical Department will be pleased to indicate the extent to which over-loads may be applied for any given loading cycle.

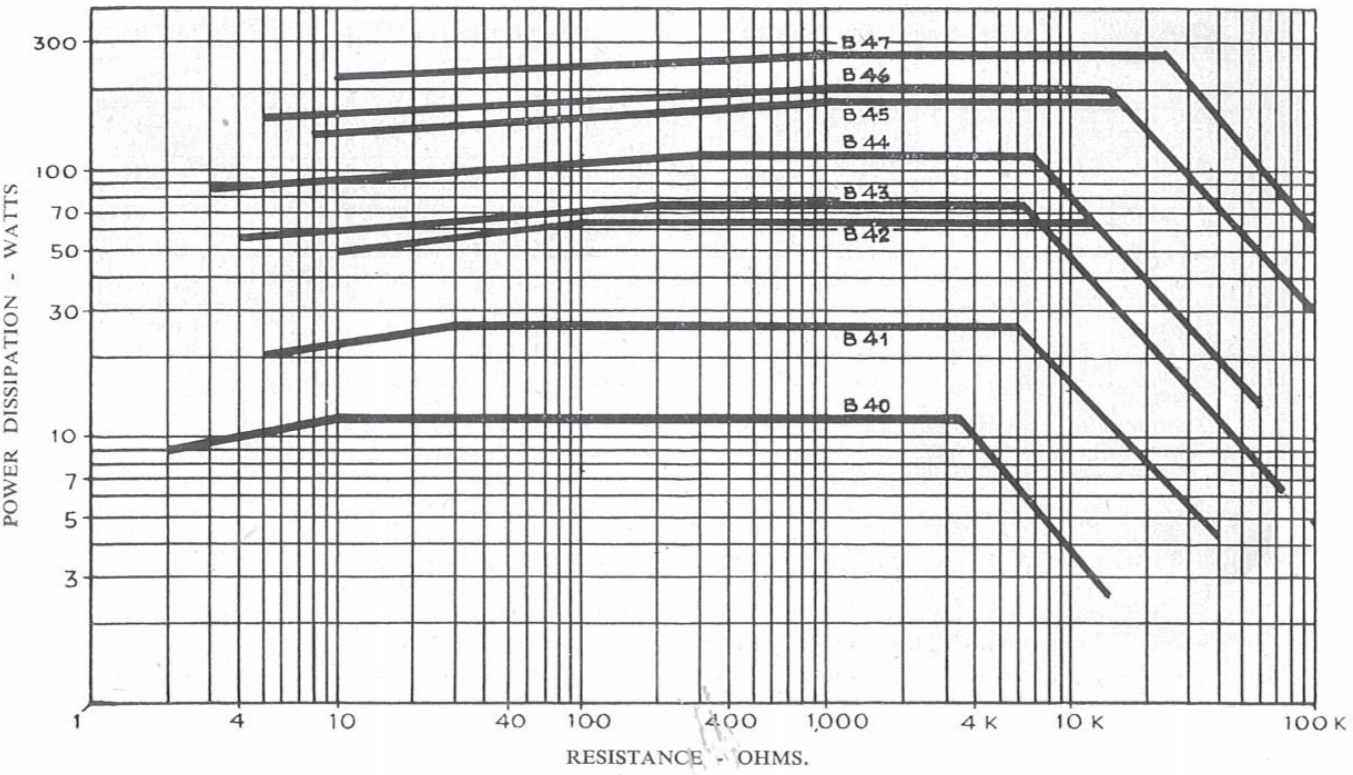
WELWYN VITREOUS RESISTORS

TEMPERATURE & LOAD CURVES—MARK IV RANGE PATTERN B



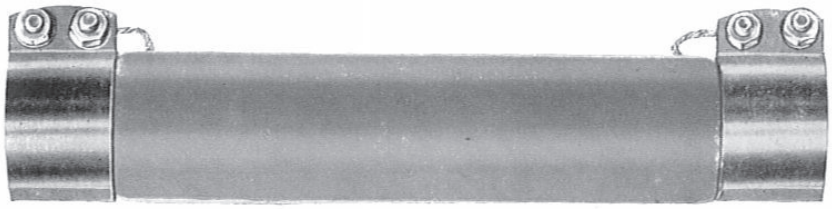
VARIATION OF MAX. SURFACE TEMPERATURE WITH POWER DISSIPATION

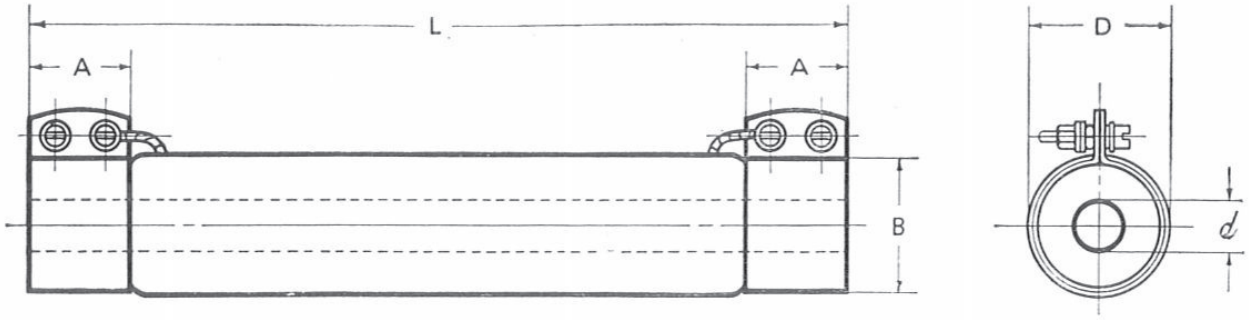
(RESISTORS VERTICAL IN FREE AIR AT 20°C. BORE UNOBSTRUCTED)



VARIATION OF POWER DISSIPATION WITH RESISTANCE

MARK III RANGE—PATTERN C





Type	*Max. Power. Continuous Watts (Wm.)*	*Ohmic Value*		*Dimensions in Inches*					*Maximum Continuous Voltage (Vm.)*
		Min.	*Max.*	d	D	L	A	B	
C 3123	30	6	25K	5/16	5/8	2- 5/8	1/2	9/16	450
C 3124	45	8	40K	5/16	5/8	3- 3/8	1/2	9/16	700
C 3125	65	10	60K	5/16	5/8	4- 7/16	1/2	9/16	900
C 3132	90	6	60K	3/8	7/8	4- 1/4	5/8	13/16	900
C 3141	115	6	80K	5/8	1-1/8	4- 1/4	5/8	1- 1/16	900
C 3134	180	6	90K	3/8	7/8	6-13/16	5/8	13/16	1800
C 3144	220	6	100K	5/8	1-1/8	6-13/16	5/8	1- 1/16	1800
C 3146	280	6	100K	5/8	1-1/8	8- 3/4	5/8	1- 1/16	2500

The maximum permissible continuous load (Wm-watts) indicated above may be applied to resistors mounted vertically in free air at a temperature of 20°C. When operating at maximum load under these conditions, the temperature on the enamelled surface is approximately 400°C.

At the higher resistance values (R-ohms), these ratings are limited by the maximum continuous voltage (Vm-volts) which may be applied between terminals and can be calculated from the formula $Wm = \frac{Vm^2}{R.}$

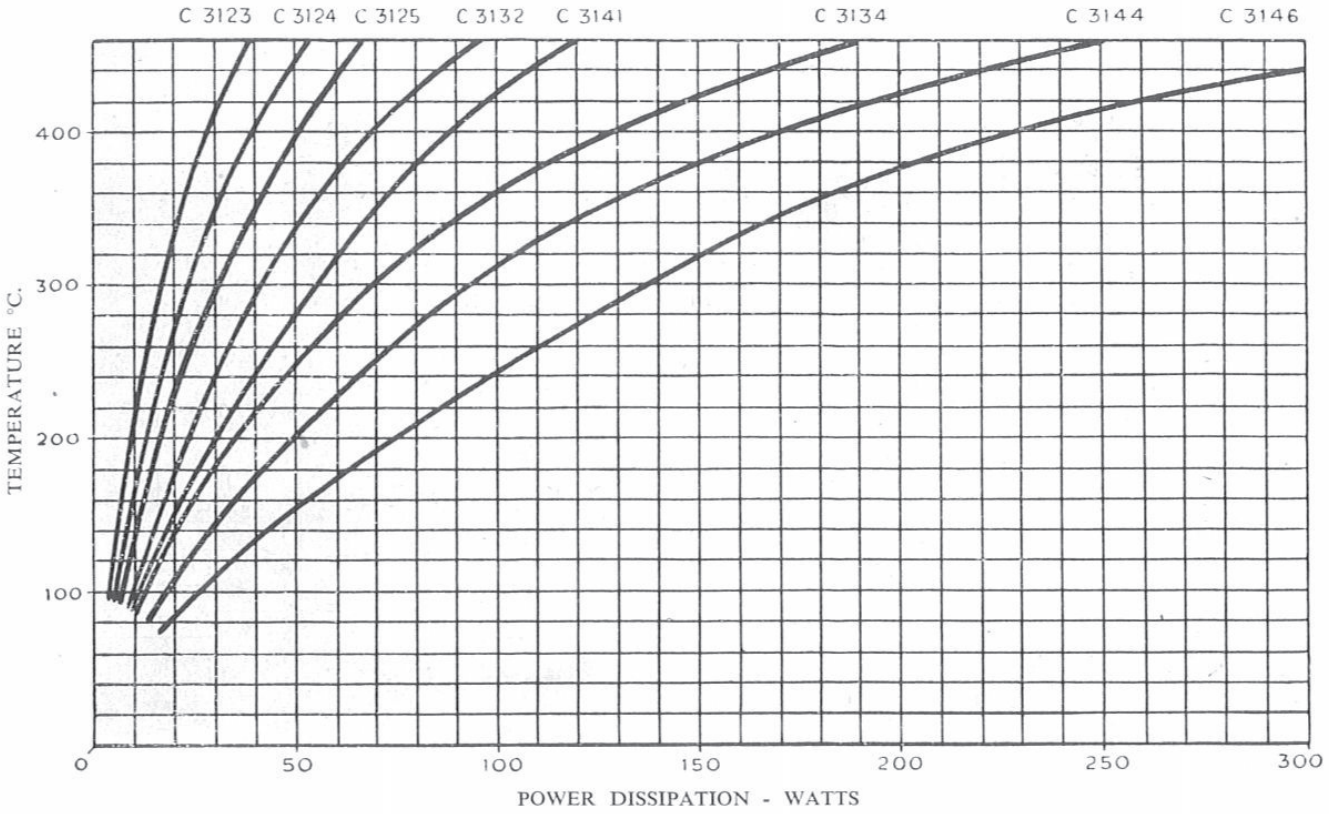
Surface temperatures for any given watts rating are illustrated by the graphs overleaf. Variation of maximum continuous load with resistance is also shewn.

Where the load is not continuous, the rating may safely exceed that indicated above. Our Technical Department will be pleased to indicate the extent to which over-loads may be applied for any given loading cycle.

Details of mounting clips and fixing centres are shown on page 21.

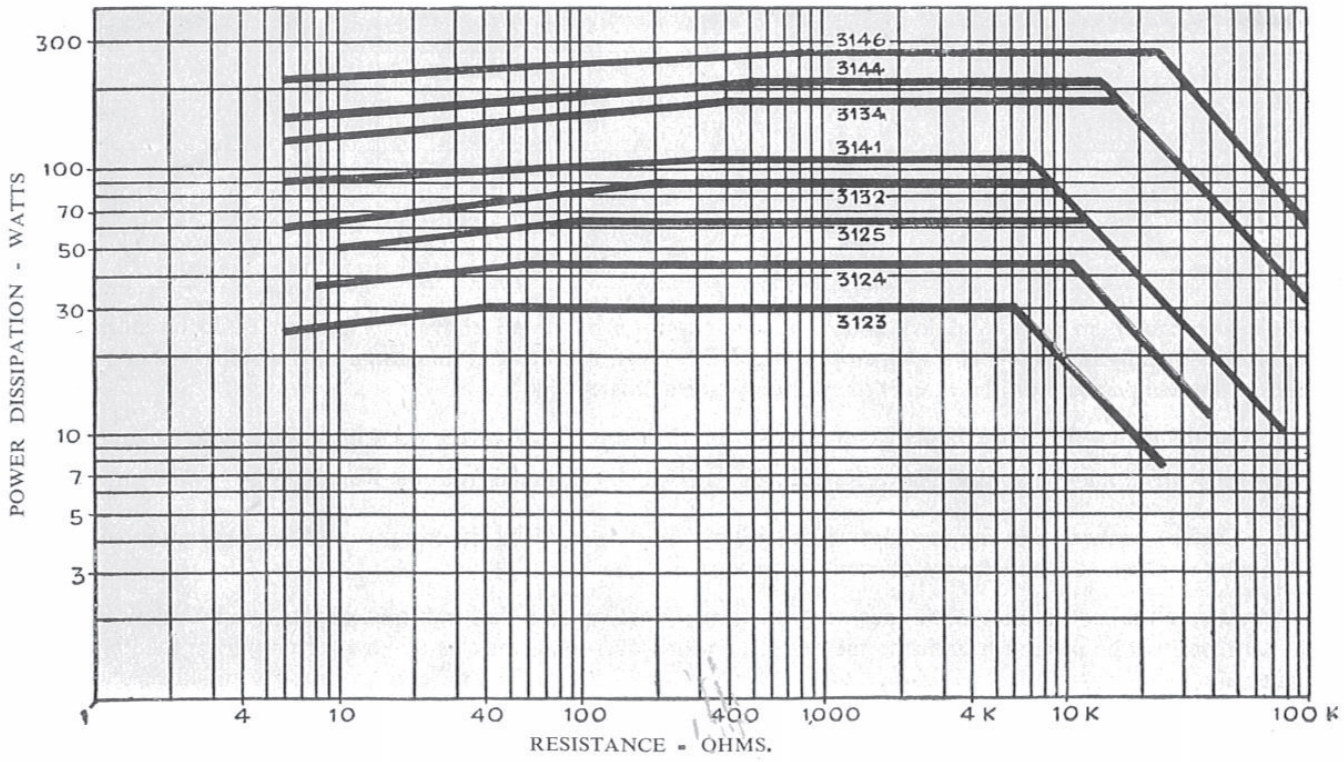
WELWYN VITREOUS RESISTORS

TEMPERATURE & LOAD CURVES—MARK III RANGE PATTERN C



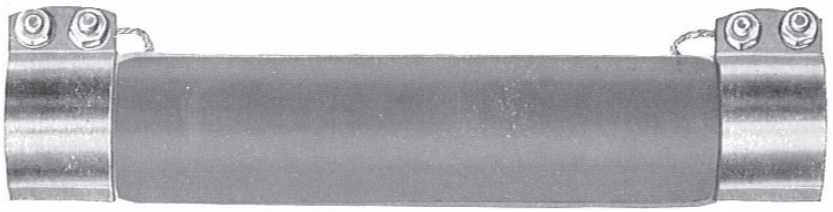
VARIATION OF MAX. SURFACE TEMPERATURE WITH POWER DISSIPATION

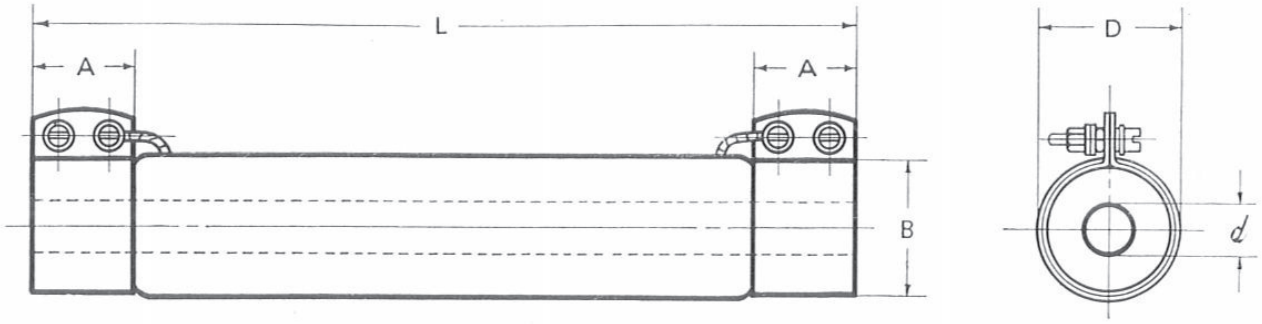
(RESISTORS VERTICAL IN FREE AIR AT 20°C., BORE UNOBSTRUCTED)



VARIATION OF POWER DISSIPATION WITH RESISTANCE

MARK IV RANGE—PATTERN C





Type	*Max. Power. Continuous Watts (Wm.)*	*Ohmic Value*		*Dimensions in Inches*					*Maximum Continuous Voltage (Vm.)*
		Min.	*Max.*	d	D	L	A	B	
C 40	18	4	35K	5/16	5/8	2-5/16	1/2	9/16	250
C 41	35	7	60K	5/16	5/8	3	1/2	9/16	550
C 42	75	10	100K	5/16	5/8	5	1/2	9/16	1100
C 43	100	4	100K	3/8	7/8	4-3/4	5/8	13/16	1000
C 44	150	5	100K	5/8	1-1/8	5-1/4	5/8	1- 1/16	1200
C 45	205	8	100K	3/8	7/8	7-3/4	5/8	13/16	2200
C 46	215	6	100K	5/8	1-1/8	7-1/4	5/8	1- 1/16	2000
C 47	300	10	200K	5/8	1-1/8	9-3/4	5/8	1- 1/16	2800

The maximum permissible continuous load (Wm-watts) indicated above may be applied to resistors mounted vertically in free air at a temperature of 20°C. When operating at maximum load under these conditions, the temperature on the enamelled surface is approximately 400°C.

At the higher resistance values (R-ohms), these ratings are limited by the maximum continuous voltage (Vm-volts) which may be applied between terminals and can be calculated from the formula $Wm = \frac{Vm^2}{R.}$

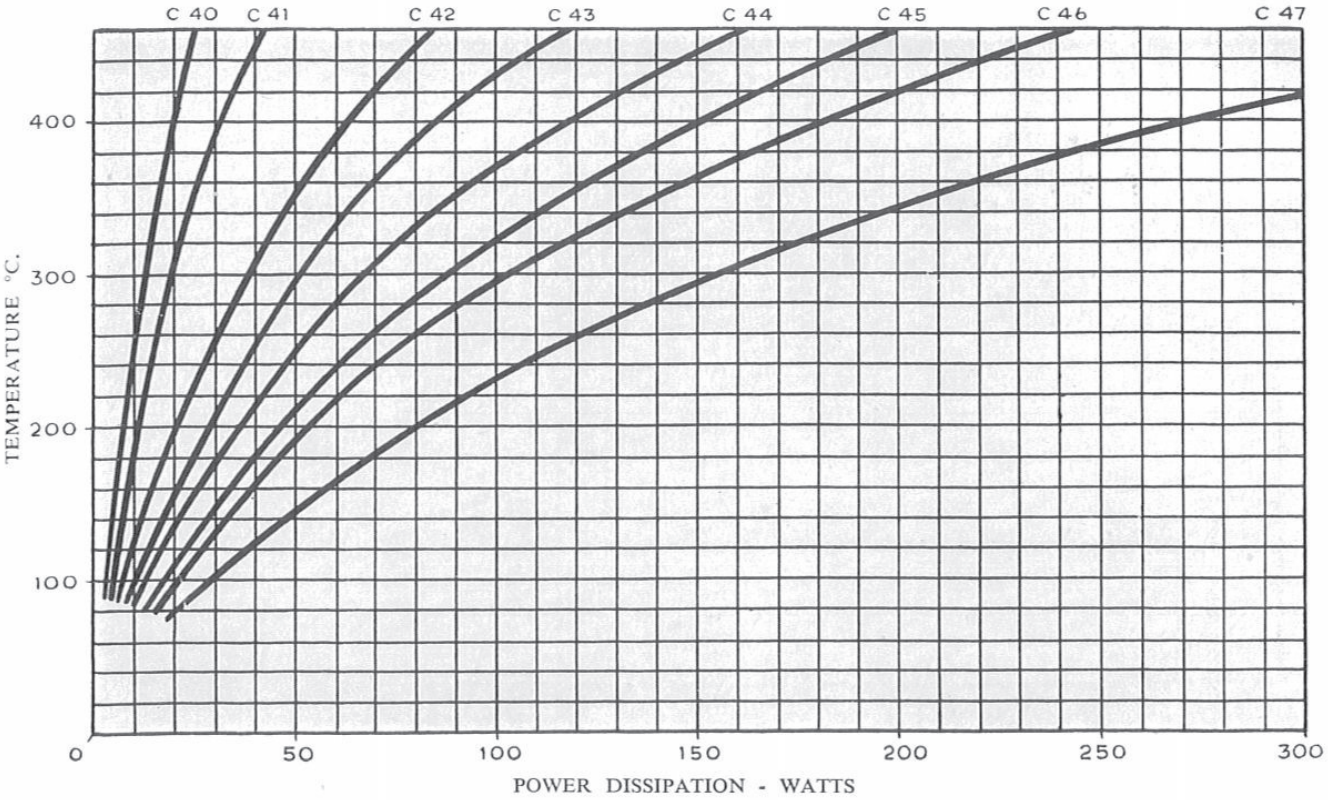
Surface temperatures for any given watts rating are illustrated by the graphs overleaf. Variation of maximum continuous load with resistance is also shewn.

Where the load is not continuous, the rating may safely exceed that indicated above. Our Technical Department will be pleased to indicate the extent to which over-loads may be applied for any given loading cycle.

Details of mounting clips and fixing centres are shown on page 21.

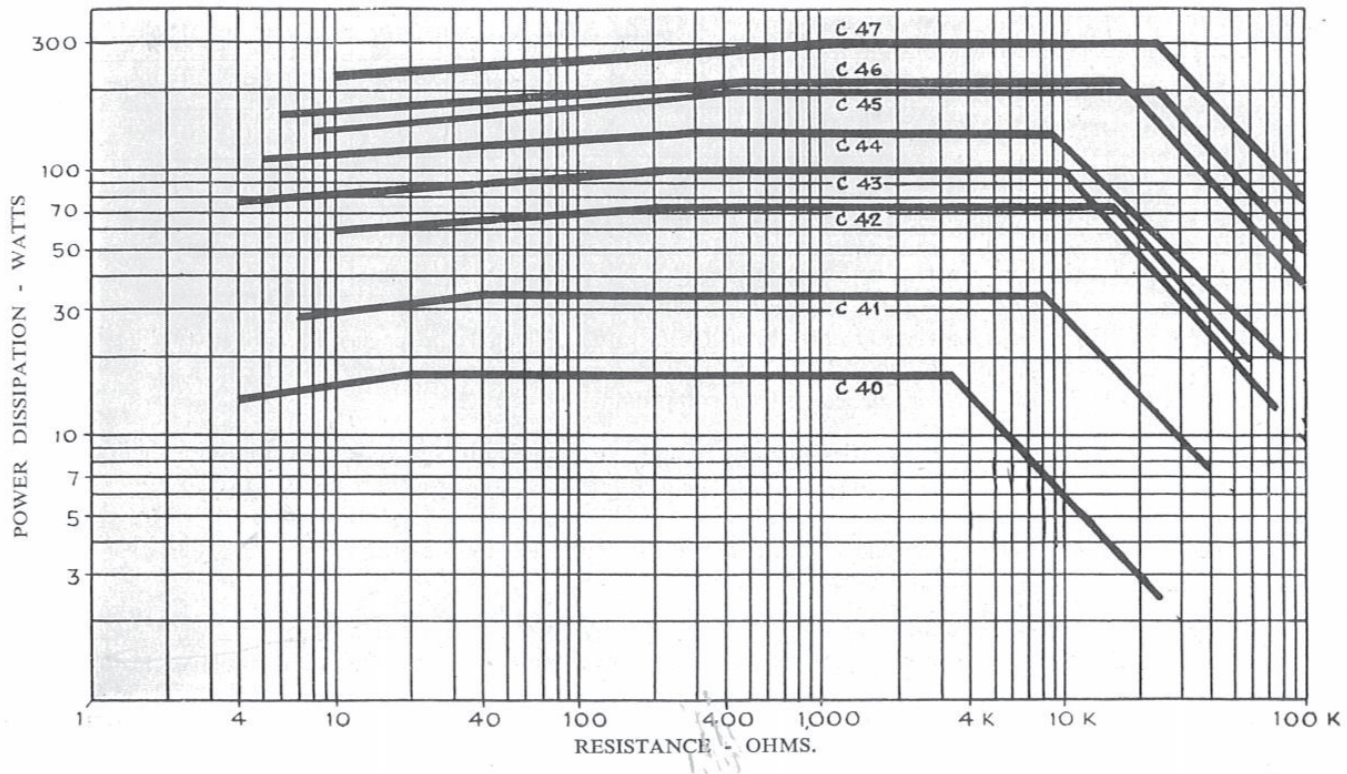
WELWYN VITREOUS RESISTORS

TEMPERATURE & LOAD CURVES—MARK IV RANGE PATTERN C



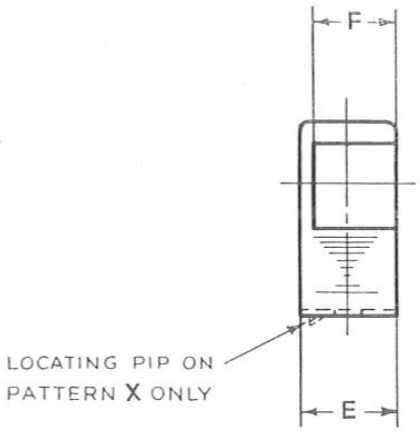
VARIATION OF MAX. SURFACE TEMPERATURE WITH POWER DISSIPATION

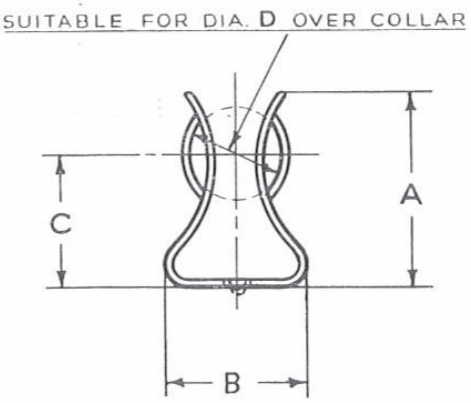
(RESISTORS VERTICAL IN FREE AIR AT 20°C., BORE UNOBSTRUCTED)



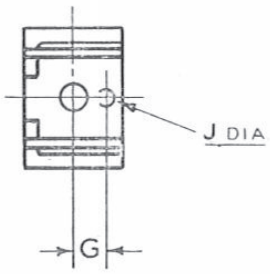
VARIATION OF POWER DISSIPATION WITH RESISTANCE

STANDARD CLIPS

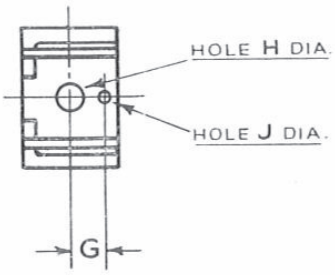




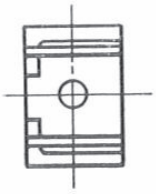
PATTERNS X, Y, Z



PATTERN X



PATTERN Y



PATTERN Z

NO.	PATTERN	DIMENSIONS IN INCHES									MATERIAL	FINISH
		A	B	C	D	E	F	G	H	J		
1	X	1 1/8	11/16	3/4	9/16	9/16	15/32	11/64	5/32	1/8	PHOS. BR. 21 S.W.G.	NICKEL PLATE
2	Y	1 3/8	1	15/16	13/16	11/16	19/32	1/4	3/16	3/32	PHOS. BR. 20 S.W.G.	,, ,,
3	Z	1 5/16	1 1/16	13/16	1 1/16	3/4	5/8	—	1/4	—	PHOS. BR. 18 S.W.G.	,, ,,
4	Z	1 7/8	1 1/4	1 5/16	1 1/16	3/4	5/8	—	1/4	—	PHOS. BR. 18 S.W.G.	,, ,,

FIXING CENTRES

TYPE	CENTRES
C40	ins. 2
C41	2 11/16
C42	4 11/16
C43	4 5/16
C44	4 13/16
C45	7 5/16
C46	6 13/16
C47	9 5/16

TYPE	CENTRES
C3123	ins. 2 5/16
C3124	3 1/16
C3125	4 1/4
C3132	3 13/16
C3141	3 13/16
C3134	6 3/8
C3144	6 3/8
C3146	8 5/16

NON-INDUCTIVE VITREOUS RESISTORS.

All types of resistors can be wound non-inductively, and the following table shows the range of values which can be obtained, manufactured with the Ayrton Perry type of winding.

Prefix letter "L" denotes this type of winding. Dimensions of non-inductive resistors are exactly similar to corresponding straight wound types.

If values not included in this list are required, our Technical Department will be pleased to receive enquiries.

Resistor Type	*Limits of Resistance*	
	Maximum Ohms	*Minimum Ohms*
AWL 3111	2,350	7
AWL 3112	3,600	9·5
AWL 3192	7,700	20
APL 40	2,250	6
APL 41	6,500	17
APL 42	18,500	47
APL 43	19,000	49
APL 44	30,000	80
APL 45	48,500	120
APL 46	56,000	140
APL 47	88,000	220
CL 40	4,250	11
CL 41	9,100	23
CL 42	22,000	55
CL 43	27,500	70
CL 44	41,500	110
CL 45	57,000	145
CL 46	66,500	170
CL 47	99,000	250
APL 3123 & CL 3123	7,300	19
APL 3124 & CL 3124	12,200	32
APL 3125 & CL 3125	18,500	47
APL 3132 & CL 3132	23,000	60
APL 3134 & CL 3134	48,500	120
APL 3141 & CL 3141	30,000	80
APL 3144 & CL 3144	62,500	160
APL 3146 & CL 3146	88,000	220

INTER-SERVICES STANDARDISATION.

The following tables indicate the Welwyn Resistors which constitute " preferred " sizes in accordance with Interim Working Schedule of Fixed Resistors No. RC.L/110.11, Issue 1, dated September, 1944, and Interim Working Schedule for Miniature Wire Wound Resistors No. RC.L/110.13m., Issue 1, May, 1944.

These sizes are most readily available and it is recommended that no other sizes be specified for new equipment.

Vitreous Wire Wound.

Size (*RC.L.*/110.11)	*I.S. Rating* (*Watts*)	*Welwyn Type*	*Welwyn Rating* (*Watts*)
RWA	7·5	C.40	18
RWB	15	C.41	35
RWC	25	C.43	100
RWD	45	C.44	150
RWE	65	C.46	200
RWF	100	C.47	300
RWG	3	AW.3111	6
RWH	5	AW.3112	12
RWJ	10	AW.3192	30
RWK	15	AW.3124	45

The I.S. Rating is based on a permissible temperature rise of 180°C. as outlined in the appropriate service specification. The Welwyn Rating is a safe continuous rating for application where high operating temperature can be tolerated and is such that in free air at 20°C. the maximum surface temperature is 400°C. approximately. For further details see " Introduction to the Catalogue."

Lacquered Wire Wound.

Size (*RC.L.*/110.11)	*RWL*	*RWM*	*RWN*	*RWP*
Welwyn Type	AW.3214	AW.32111	AW.32921	AW.3227

High Stability Carbon (Grade 1).

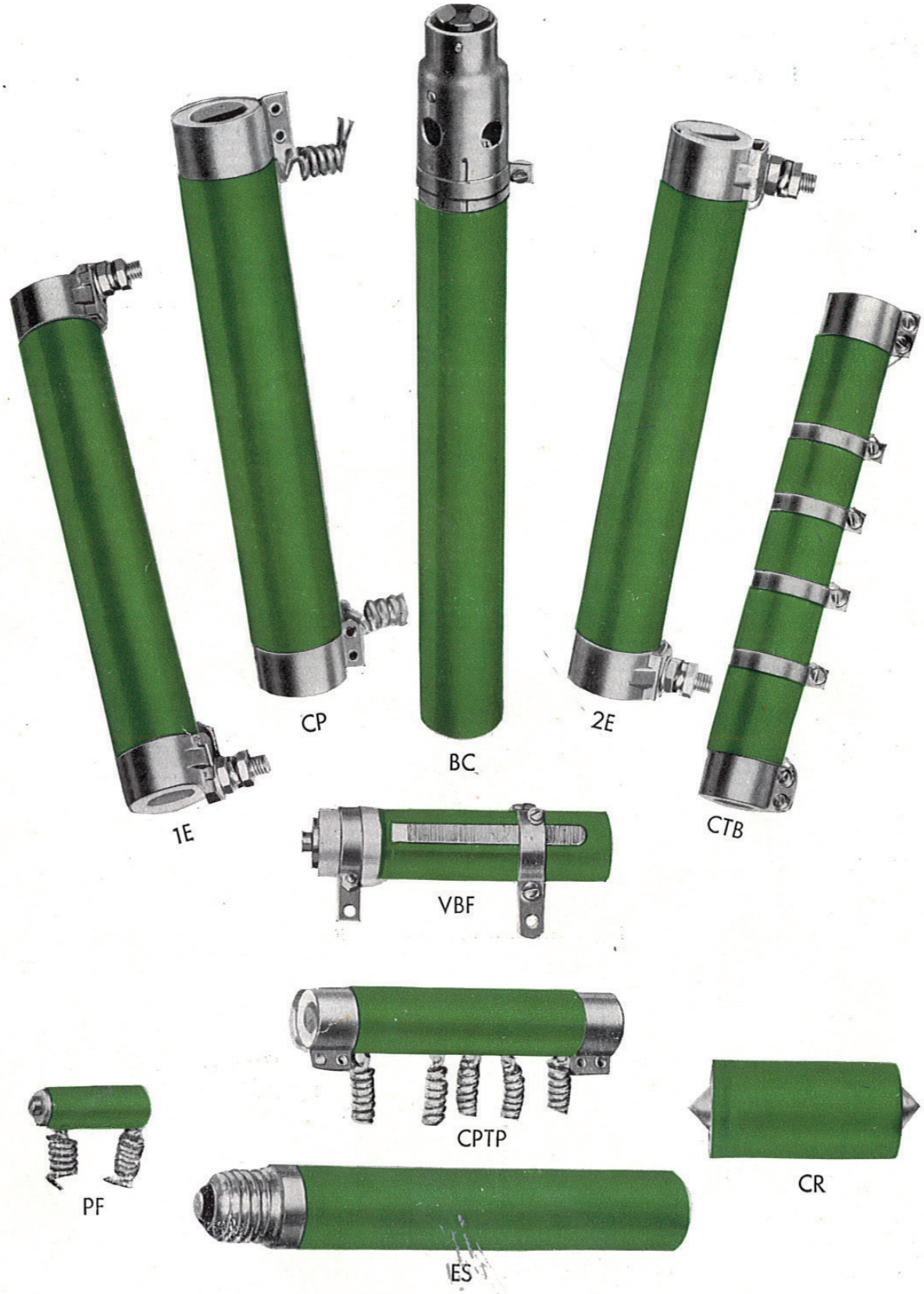
Size (*RC.L*/110.11)	*RCD*	*RCC*	*RCB*	*RCA*
Welwyn Type	A.3622	A.3623	A.3634	A.3635

Miniature Wire Wound.

Rating (*Watts*) (*RC.L*/110.13)	$\frac{1}{4}$	1	$2\frac{1}{2}$	4
Welwyn Type	AW.3271*	AW.3101	AW.3115	AW.3111

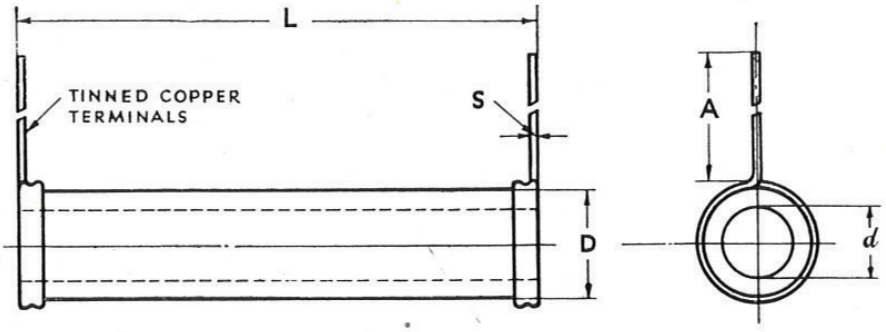
* Duplicate in size of Type AW.3101 but with lacquer finish and limited range of resistance values.

SPECIAL TYPES



SECTION II

WELWYN WIRE WOUND LACQUERED RESISTORS



Type	*Watts*	*Ohms*		*Dimensions in Inches*				S
		Min.	*Max.*	d	D	L	A	
AW 3214	3/4	1	5,000	5/64	1/4	3/4	2	20 S.W.G.
AW 32111	1	1	10,000	5/64	1/4	1-3/8	2	20 S.W.G.
AW 32921	2	4·7	20,000	1/4	13/32	1-1/2	2	20 S.W.G.
AW 3227	4	10	50,000	5/16	1/2	2-3/8	2	18 S.W.G.

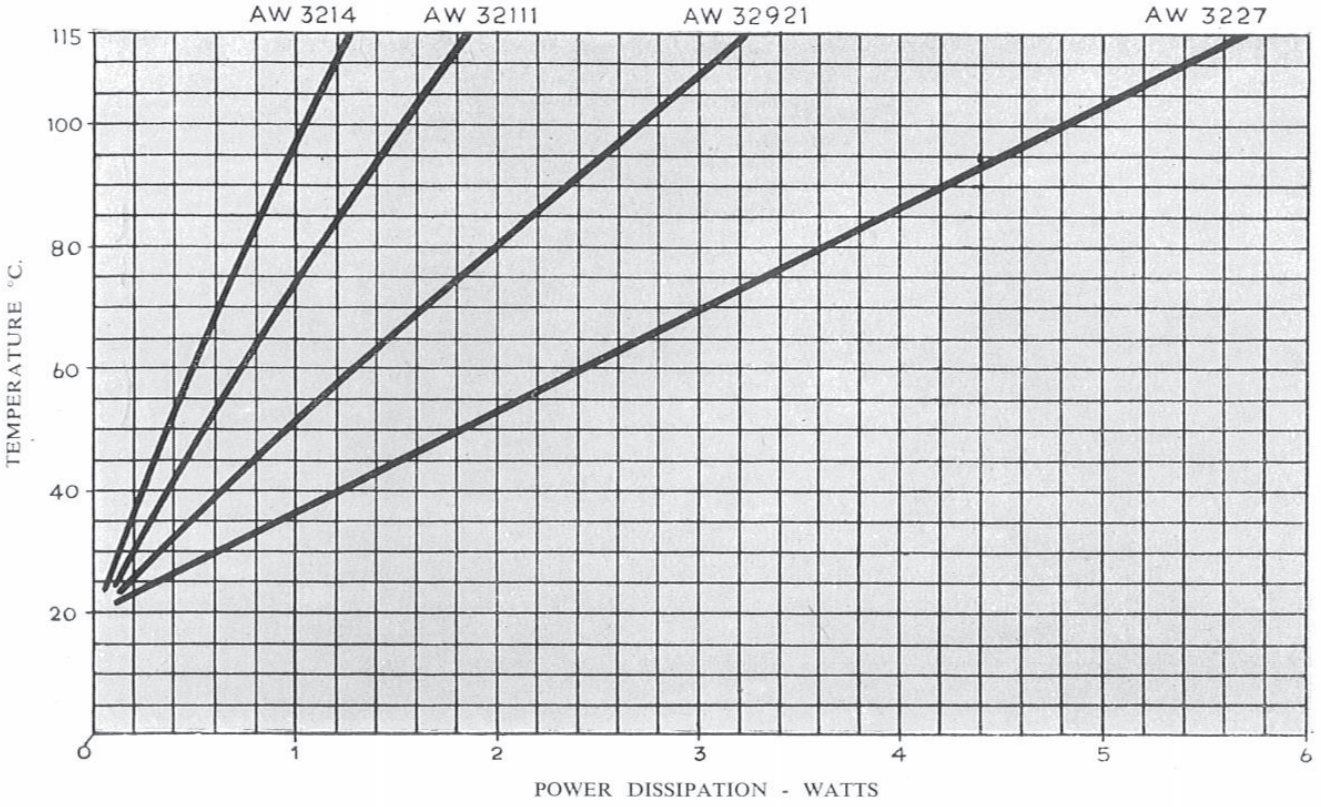
The above watts ratings may be applied continuously to resistors operating in an ambient temperature of 60°C.—70°C. and produce a temperature rise of 60°C.

In applications where the ambient temperature does not reach the above figure, the load may be increased, provided the surface temperature does not exceed 130°C.

Temperature-load curves are shewn overleaf.

WELWYN LACQUERED RESISTORS

TEMPERATURE CURVES—PATTERN AW

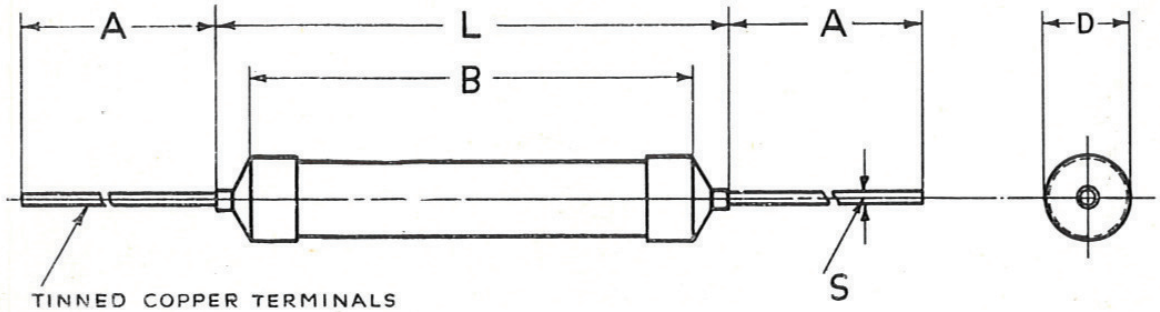


VARIATION OF MAX. SURFACE TEMPERATURE WITH POWER DISSIPATION

RESISTORS HORIZONTAL IN FREE AIR AT 20°C., BORE UNOBSTRUCTED)

SECTION III

WELWYN HIGH STABILITY CARBON RESISTORS



Type	Nom. Watts	Tolerance	Ohms.* Min.	Ohms.* Max.	Nominal Dimensions in Inches D	L	A	B	S
A 3622	1/4	5%	10	1Meg.	3/16	1	1-1/2	3/4	20 S.W.G.
		2%	50	510,000					
		1%	100	250,000					
A 3623	1/2	5%	10	3Meg.	3/16	1-9/32	1-1/2	1-1/32	20 S.W.G.
		2%	50	1M					
		1%	100	750,000					
A 3634	1	5%	10	5Meg.	11/32	1-9/16	1-1/2	1-7/32	20 S.W.G.
		2%	50	1-5Meg.					
		1%	100	1Meg.					
A 3635	2	5%	10	8Meg.	11/32	2-1/4	1-1/2	1-7/8	20 S.W.G.
		2%	50	3Meg.					
		1%	100	2Meg.					

*See over

Tolerance.

Resistors are supplied to within ±5%, ±2% or ±1% of the nominal value.

The widest permissible resistance tolerance should always be specified.

Finish.

Tropical Grade to comply with W.T. Spec. K.110.

Noise Level.

Very low.

Age Stability.

The stability under tropical conditions as simulated by Spec. K.110 is 1% for values up to 30,000 ohms and 2% over 30,000 ohms. This is, therefore, the maximum permanent change in resistance to be expected during the life of a resistor when operating in the Tropics.

Temperature Co-efficient.

Temperature Co-efficient	A 3622	A 3623	A 3634	A 3635
·02—·03% per °C.	10 – 51K ohms	10 –100K ohms	10 –200K ohms	10 –390K ohms
·03—·04% ,, ,,	51K–100K ,,	100K–200K ,,	200K–390K ,,	390K–820K ,,
·04—·07% ,, ,,	100K– 1M ,,	200K– 2M ,,	390K–3·9M ,,	820K–5·1M ,,

Temperature Rise.

The approximate maximum body temperature rise for resistors continuously loaded at the nominal rating are shewn in the table below.

Resistor Type	*Continuous Rating (Watts)*	*Maximum Body Temperature Rise (°C.)*
A 3622	1/4	25
A 3623	1/2	45
A 3634	1	50
A 3635	2	80

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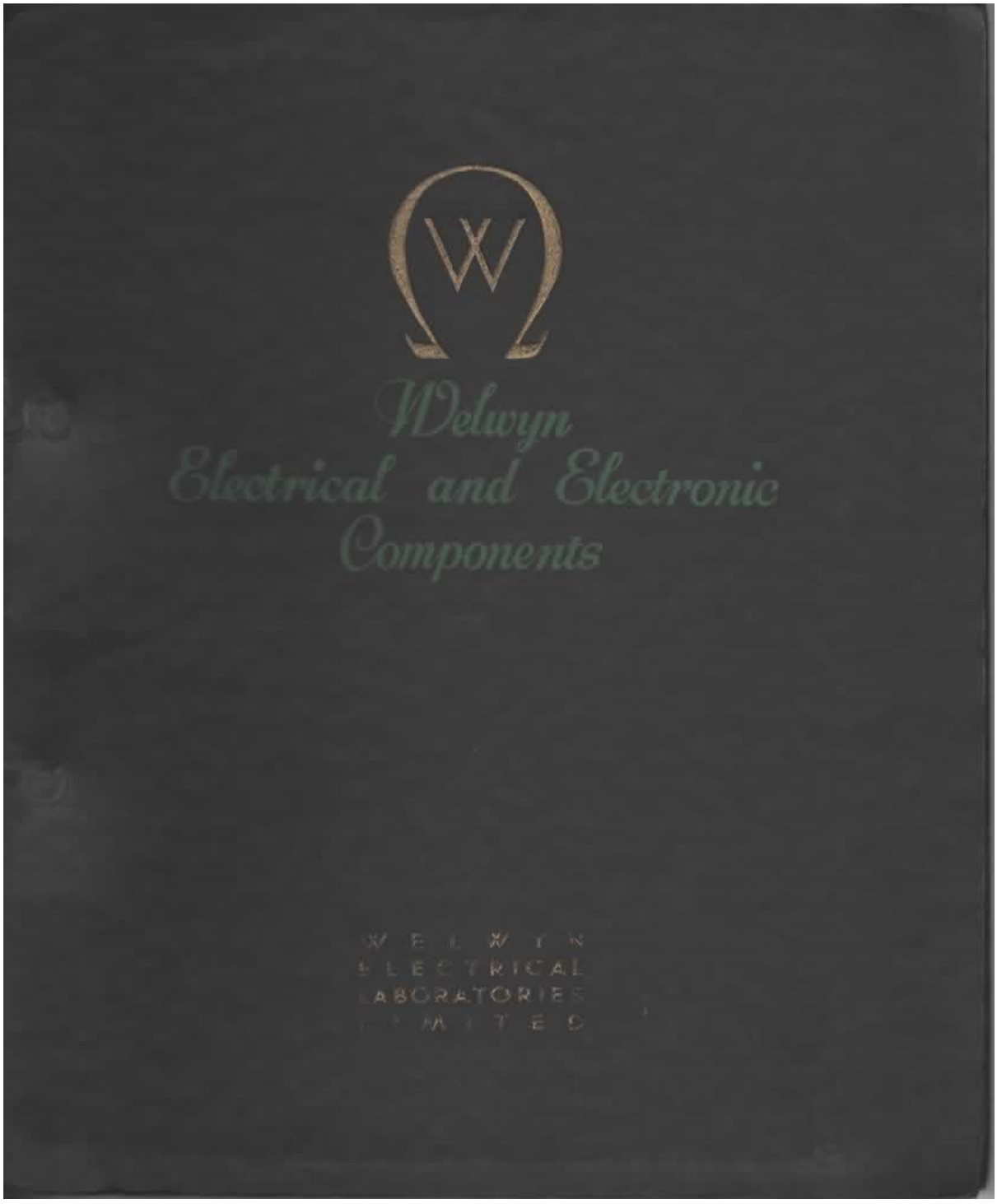
LEWISHAM, S.E.13, & BROADWAY COURT, S.W.1.

Following is a catalogue from the 1950s in similar format but showing growth and diversification of the product range.

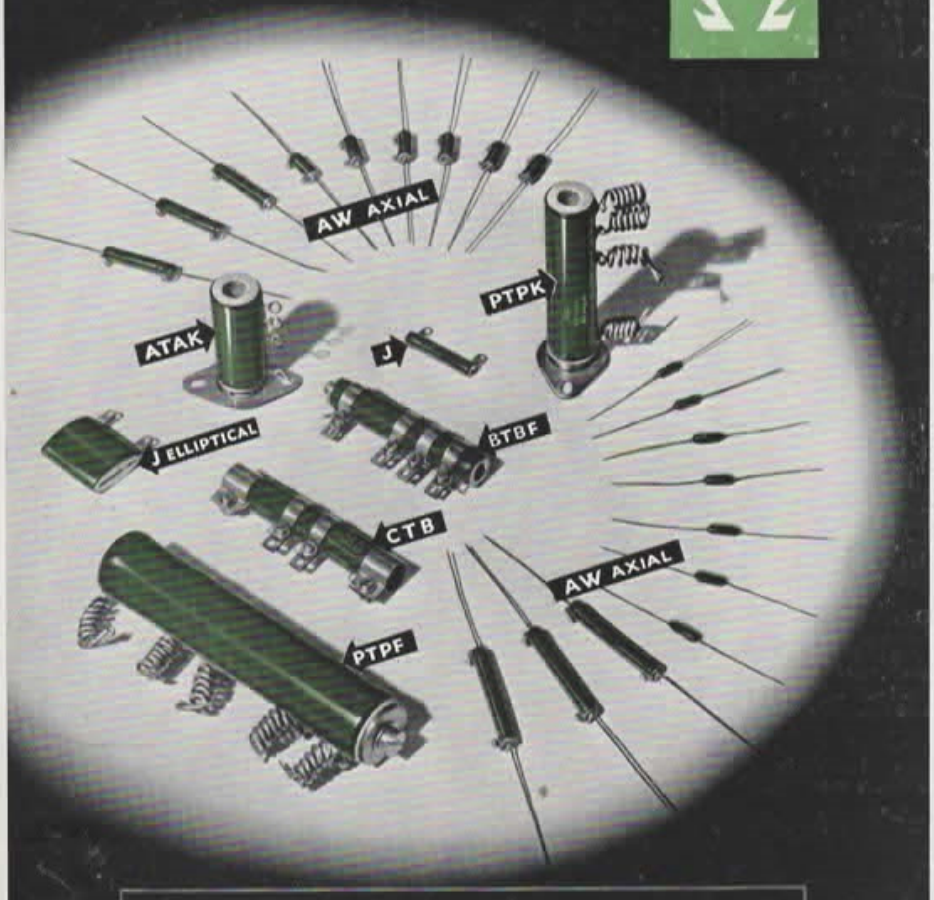

Welwyn
Electrical and Electronic
Components
WELWYN
ELECTRICAL
LABORATORIES
LIMITED

SECTION 1

VITREOUS ENAMELLED WIRE WOUND RESISTORS

WELWYN ELECTRICAL LABORATORIES LIMITED
BEDLINGTON STATION • NORTHUMBERLAND
PHONE: BEDLINGTON 2181 *GRAMS:* RESISTOR BEDLINGTON
ALSO AT QUADRANT HOUSE LONDON S.W.1.
PHONE: WHITEHALL 0184-5 *GRAMS:* WELISTOR PICCY LONDON

Vitreous Enamel Wire-Wound Resistors



INFORMATION AND PAMPHLETS ON OTHER WELWYN PRODUCTS AVAILABLE ON REQUEST

VITREOUS ENAMELLED WIRE WOUND RESISTORS

1. Vitreous enamelled wire wound resistors should be specified for applications where absolute reliability under all conditions is necessary and where a high dissipation of power is to be achieved in a relatively small space.
2. This section of the Welwyn Electrical Laboratories' catalogue lists the standard types of vitreous enamelled wire wound resistors. Each size and pattern is designated by a code in which the prefix letters refer to the type of terminal and the figures refer to the size and thus to the rating. It should be borne in mind that a variety of other styles (illustrated on pages 1 and 20) are available and, where necessary, terminations will be designed to suit customers' requirements. Resistors of non-standard ratings and sizes can also be supplied fitted with standard terminals.
3. The high standard of performance of the Welwyn resistors is due to a large extent to the excellent properties of the protective enamel. This enamel, which is fired on at a high temperature, is completely non-porous, is free from crazing or cracks and is resistant to corrosion from all normal atmospheric agents and the common acids and alkalies. It enables the resistors to operate at a surface temperature of 400°C. with a very large margin of safety on overload.

CONSTRUCTION

4. The method of construction contributes largely to the reliability of the components. The resistance element is of selected nickel chromium alloy and this is electrically welded to the end connections of similar alloy which are bound securely to the tube. Thus no dissimilar metals come into contact below the surface of the enamel and any deterioration by electrochemical action is avoided. The use of one alloy also reduces the possibility of thermal E.M.F.s. The formers, on which the resistive elements are wound, are of high quality ceramic and are capable of withstanding thermal shock.
5. On most patterns of resistor the terminals are hard soldered to the end connections and are also secured directly to the ceramic former so that no mechanical stress can be transmitted to the resistance element by a movement of the terminals.
6. The vitreous enamel affords complete mechanical and chemical protection to the resistance wire and allows wire of the finest gauges to be used. The range of resistance values available in each size is therefore extensive.

PROPERTIES

7. Welwyn vitreous enamelled resistors meet all the performance requirements of the Joint-Services' specification RCS/111. All resistors of the preferred patterns adopted by the Services have been type approved.
8. The stability of these components is such that after dissipating power for 1,000 hours at the rating as specified in the catalogue, and thus operating at a temperature of approximately 400°C., the maximum change in resistance is 1.5%.
9. The temperature coefficient of resistance will not exceed 200 parts per million per degree Centigrade on any resistor and is positive. On most resistors, the temperature coefficient will be less than 100 parts per million.
10. Resistors are normally wound to a tolerance of ±5% and can be supplied to any value in the ranges listed. For the lowest values, the tolerance is restricted to ±10%.
11. The dimensions shown in the table are nominal and are subject to the following tolerances :—
    Pattern C : Length ± 1/16" — 1/8".
    Diameter ± 1/16".
    All other Patterns : Length ± 1/16".
    Diameter ± 1/16".
12. Resistors are normally marked with the Welwyn designation, the resistance and the tolerance in indelible white characters. The marking of Joint-Services designations can be provided when required.

SELECTION OF PATTERN AND SIZE OF RESISTOR

13. In determining the pattern of resistor to be employed, consideration must be given to the dissipation required, the space and mounting facilities available, the permissible surface temperature and the possible need for interchangeability. Thus for the smaller power dissipating units, a type of resistor capable of being soldered into circuit and supported by the terminal wires may be used. This type is referred to as pattern AW, and is available in a range of sizes from 3 watts to 45 watts dissipation for a temperature rise of approximately 400°C.
14. The larger units, which have ratings of up to 300 watts, are in general too heavy to be supported by their terminal wires. They may be held by brackets or by inserts fitting in the bores, and may be provided with terminals consisting of bands (pattern B) or copper flex (pattern AP). Alternatively, the resistors may be fitted with collars which provide the electrical connection and at the same time allow secure fixing in spring clips. This type (pattern C) also allows easy interchange of resistors. All tubular patterns should be mounted vertically, if possible, allowing circulation of cooling air through the bore. The AW pattern with axial leads may be mounted in any position.
15. The resistors wound on elliptical formers provide a useful range for applications where space is limited. If mounted by a metal bracket passed through the bore of the resistor and connected to a heat dissipating body, some increase in rating above that specified for mounting in air is possible.
16. The size of resistor to be used is determined by taking into account the acceptable surface temperature and the ambient temperature under operating conditions, and making allowances for the proximity of other heat dissipating components, constriction of the bore, or horizontal mounting when this is adopted. Thus the rating should be reduced by 15% when a tubular resistor is mounted horizontally and by the same amount when mounted vertically with the bore obstructed. If another component of similar size and surface temperature is mounted at two diameters distance, a derating of 10% should be allowed.

VITREOUS ENAMELLED WIRE WOUND RESISTORS

17. The curves in this catalogue show, for each size and pattern of resistor, the maximum surface temperature against power dissipation, when the resistor is mounted vertically in free air at 20°C. with the bore unobstructed. The curves may be used to evaluate the rating when the maximum permissible surface temperature and the ambient temperature are known. The point on the curve corresponding to the allowable temperature rise gives the dissipation under these conditions. For example, a resistor type AW3112 (normal rating 14 watts) operating in an ambient of 60°C. with a maximum surface temperature of 350°C. has a permissible temperature rise of 290°C. Reading from the relevant curves, on page 4, it will be seen that this corresponds to a rating of 9 watts.

18. The permissible dissipation of resistors towards the top of the resistance range is limited by the maximum continuous voltage which may be applied. On very low values some derating is applied in order to avoid excessive temperature gradients. The second graph on each page indicates the derating necessary for those reasons.

19. Resistors are wound to customers' requirements and are normally supplied to a tolerance of ±5%, although closer tolerances are available to special order. On the lowest values the tolerance is restricted to ±10% as indicated in the appropriate tables.

TAPPED RESISTORS

20. All types of resistors except AW3101 and AW3115 can be supplied with tappings. The connections to the tappings can be made by terminals similar to the end connectors or by some alternative means. Tapped resistors are designated by including the letter T in the prefix. Thus prefix CTB would refer to a resistor with the end terminals consisting of collars for insertion in clips (pattern C) and the intermediate connections made to bands (pattern B).

21. The provision of tappings will reduce the rating to an extent dependent on the resistor size and number of tappings. Further information will be found on page 18.

RESISTORS OF LOW REACTANCE

22. Resistors which are single layer solenoid wound in the normal manner do not deviate appreciably from their D.C. resistance when measured at power or audio frequencies. At radio frequencies, the inductance and capacitance have a considerable effect on the impedance, and resistors with modified windings are supplied for these applications. For low inductance, Ayrton-Perry winding is adopted; modified winding can also be arranged to reduce the capacitance. The ratings and range of values of these types are given on page 19.

RATINGS FOR INTERMITTENT OPERATION

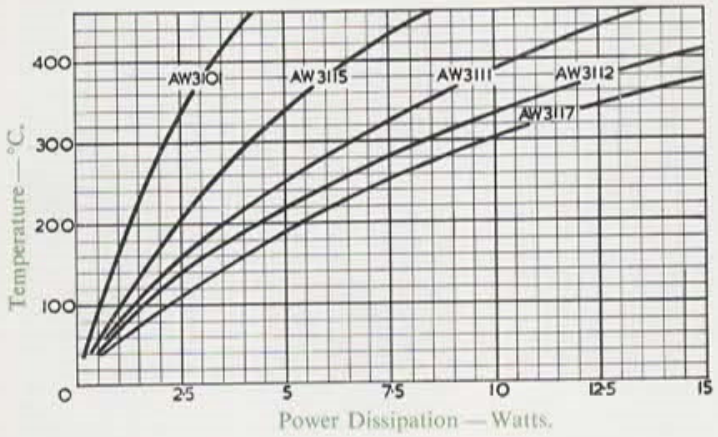
23. In applications where a resistor does not dissipate power continuously, it may be operated above its standard rating provided that the surface temperature does not exceed the normal maximum value at any time. When the power applied is in the form of a pulse, the maximum instantaneous dissipation is determined by the thermal capacity of the resistance wire and the aforementioned consideration does not apply. Welwyn Electrical Laboratories will be pleased to advise the ratings that may be applied to resistors used with a given cycle of operating conditions.

JOINT SERVICES APPROVED PATTERNS

24. For convenience of reference, the Services designations, ratings and ranges are tabled below against the Welwyn equivalents. It should be noted that the Services ratings are based on an ambient temperature of 70°C. and surface temperature of 320°C. whereas the Welwyn catalogue ratings are based on temperatures of 20°C. and 400°C.

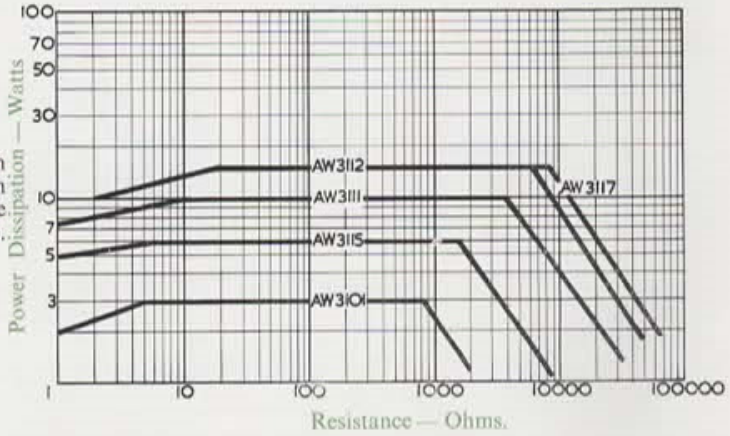
Present I.S.S.C.		*Superseded I.S.S.C.*		*Welwyn Electrical Laboratories'*		*Resistance*
Style and Rating	*(Watts)*	*Style and Rating*	*(Watts)*	*Type and Rating*	*(Watts)*	*Range (Ohms)*
RWV1-J	10	RWA	7.5	C40	18	10-7,500
RWV1-K	15	RWB	15	C41	35	10-20,000
RWV1-L	30	RWC	25	C43	100	10-30,000
RWV1-M	45	RWD	45	C44	150	10-50,000
RWV1-N	70	RWE	65	C46	215	10-75,000
RWV1-P	100	RWF	100	C47	300	10-100,000
RWV3-J	1.5	—	1	AW3101	3	10-4,700
RWV4-J	3	—	—	AW3115	6	10-9,100
RWV4-K	4.5	RWG	3	AW3111	10	10-33,000
RWV4-L	6	RWH	5	AW3112	14	10-56,000
RWV5-J	10	RWJ	10	AW3192	30	10-56,000
RWV5-K	15	RWK	15	AW3124	45	10-47,000

VITREOUS ENAMELLED WIRE WOUND RESISTORS
PATTERN AW — AXIAL LEADS



Variation of maximum surface temperature with power dissipation (see paragraph 17, page 3).

Variation of maximum permissible dissipation with resistance (see paragraph 18, page 3).



RANGE OF RESISTANCE VALUES

Type	*Rating (Watts)*	*Maximum Continuous Voltage*	*Range (Ohms)*			*R.I.C. Pattern Number*	*I.S.S.C. Style*
			Min. at ±10%	*Min. at ±5%*	*Maximum*		
AW3101	3	50	0.5	20	4,700	111-A-01	RWV3-J
AW3115	6	100	0.5	15	9,100	111-A-03	RWV4-J
AW3111	10	200	1	10	33,000	111-A-05	RWV4-K
AW3112	14	300	2	15	56,000	111-A-07	RWV4-L
AW3117	14	350	—	6,500	68,000	111-A-07	RWV4-L

VITREOUS ENAMELLED WIRE WOUND RESISTORS

PATTERN AW — AXIAL LEADS

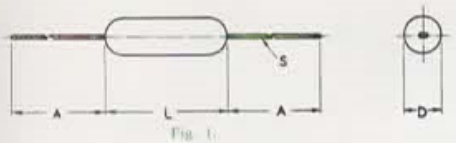


Fig. 1.

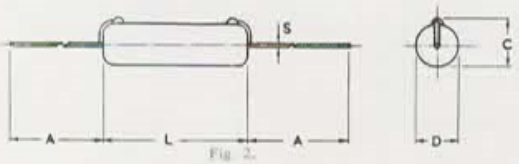


Fig. 2.

The terminals are of tinned copper strip or wire.

Resistors can be supplied in any value at the appropriate tolerance in the ranges tabled opposite. Resistors to a closer tolerance can be made to special order.

The ratings quoted in the tables are based on the permissible dissipation when operating in free air at a temperature of 20°C; operation at these ratings will produce a surface temperature of approximately 400°C. For applications at higher ambient temperatures, some derating will apply—see paragraph 17, page 3.

The reduction in the ratings of units which have a resistance near the extremes of the range is shown on the graphs opposite. Paragraph 18, page 3 refers.

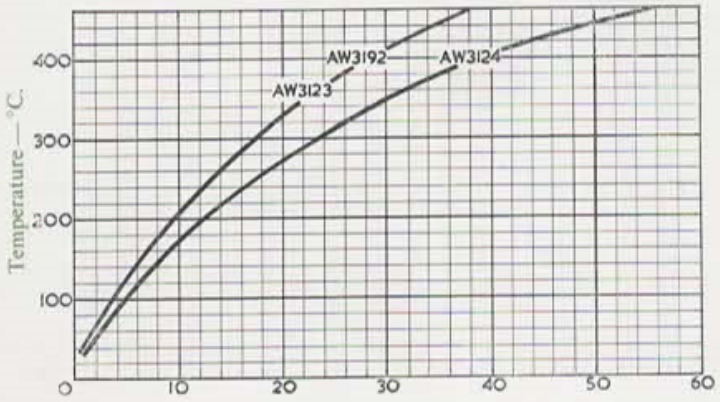
The ranges of non-inductively wound resistors of this pattern are given on page 19.

When ordering, resistors should be specified by the type, resistance and tolerance: for example AW3112/700Ω ± 5%.

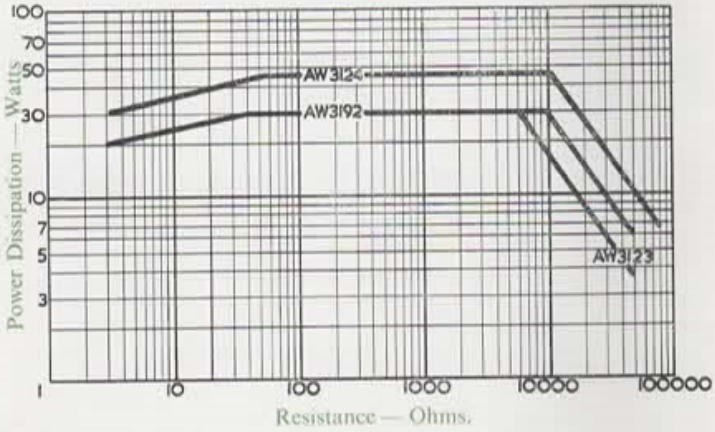
DIMENSIONS

Type	*Rating (Watts)*	*Diagram*	*Dimensions (Inches)*					*Weight (Grms.)*	*I.S.S.C. Style*
			L	D	(*Max*) C	A	S		
AW3101	3	Fig. 1	$\frac{7}{16}$	$\frac{5}{32}$	—	$1\frac{1}{2}$	.03x.0148	0.5	RWV3-J
AW3115	6	Fig. 2	$\frac{5}{8}$	$\frac{9}{32}$	$\frac{15}{32}$	2	20 SWG	2.5	RWV4-J
AW3111	10	Fig. 2	$1\frac{3}{8}$	$\frac{9}{32}$	$\frac{15}{32}$	2	20 SWG	4.0	RWV4-K
AW3112	14	Fig. 2	$1\frac{3}{4}$	$\frac{9}{32}$	$\frac{15}{32}$	2	20 SWG	6.0	RWV4-L
AW3117	14	Fig. 2	2	$\frac{9}{32}$	$\frac{15}{32}$	2	20 SWG	7.0	RWV4-L

VITREOUS ENAMELLED WIRE WOUND RESISTORS
PATTERN AW — RADIAL LEADS



Variation of maximum surface temperature with power dissipation (see paragraph 17, page 3).



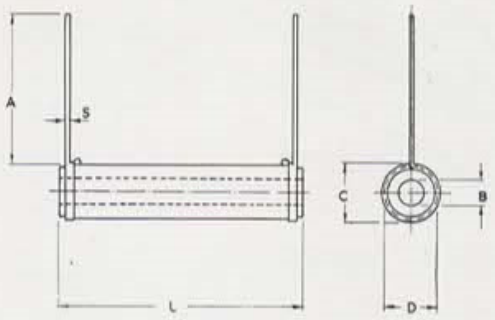
Variation of permissible dissipation with resistance (see paragraph 18, page 3).

RANGE OF RESISTANCE VALUES

Type	*Rating (Watts)*	*Maximum Continuous Voltage*	*Range (Ohms)*			*R.I.C. Pattern Number*	*I.S.S.C. Style*
			Min. at ±10%	*Min. at ± 5%*	*Maximum*		
AW3192	30	550	3	30	56,000	111-A-10	RWV5-J
AW3123	30	450	3	30	50,000	—	—
AW3124	45	700	3	35	83,000	111-A-12	RWV5-K

VITREOUS ENAMELLED WIRE WOUND RESISTORS

PATTERN AW — RADIAL LEADS



These resistors should be mounted vertically allowing free passage of air through the bore. The terminals are of tinned copper wire and may be used to support the resistors.

Units can be supplied in any value at the appropriate tolerance in the ranges tabled opposite. Resistors to a closer tolerance can be supplied to special order.

The ratings quoted in the tables are based on the permissible dissipation when operating in free air at a temperature of 20°C ; operation at these ratings will produce a surface temperature of approximately 400°C. For applications at higher ambient temperatures, some derating will apply — see paragraph 17, page 3.

The reduction in rating of units which have a resistance near the extremes of the range is shown on the graphs opposite. Paragraph 18, page 3 refers.

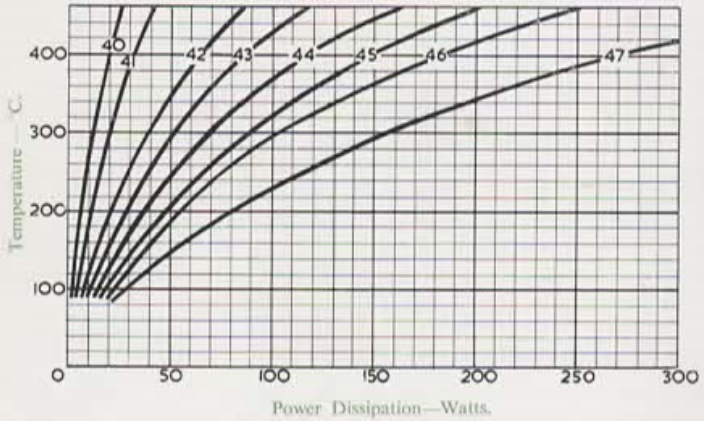
The ranges of non-inductively wound resistors of this pattern are given on page 19.

When ordering, resistors should be specified by type, resistance and tolerance ; for example, AW3124/490 Ω ± 5%.

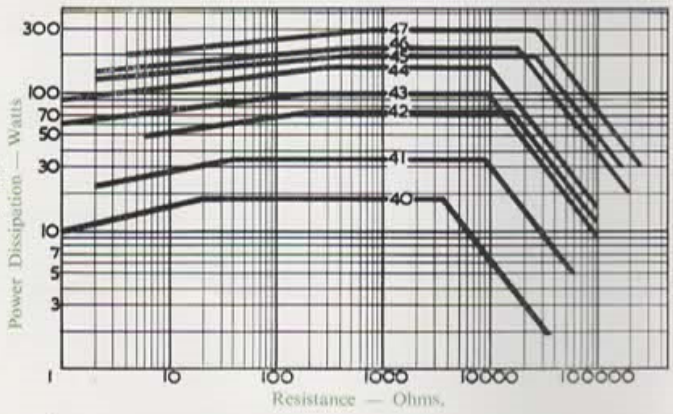
DIMENSIONS

Type	*Rating (Watts)*	*Dimensions (Inches)*						*Weight (Grms.)*	*I.S.S.C. Style*
		L	D	(*Max*) C	B	A	S		
AW3192	30	$2\frac{3}{8}$	$\frac{1}{2}$	$\frac{11}{16}$	$\frac{1}{4}$	2	18 SWG	14	RWV5-J
AW3123	30	$2\frac{1}{8}$	$\frac{5}{8}$	$\frac{13}{16}$	$\frac{5}{16}$	2	18 SWG	20	—
AW3124	45	$2\frac{7}{8}$	$\frac{5}{8}$	$\frac{13}{16}$	$\frac{5}{16}$	2	18 SWG	24	RWV5-K

VITREOUS ENAMELLED WIRE WOUND RESISTORS
PATTERN C



Variation of maximum surface temperature with power dissipation (see paragraph 17, page 3)



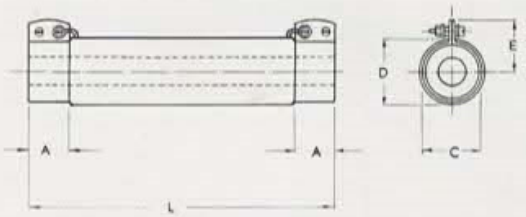
Variation of permissible dissipation with resistance see paragraph 18, page 3).

RANGE OF RESISTANCE VALUES

Type	*Rating (Watts)*	*Maximum Continuous Voltage*	*Range (Ohms)*			*R.I.C. Pattern Number*	*I.S.S.C. Style*
			Min. at ± 10%	*Min. at ± 5%*	*Maximum*		
C40	18	250	1	30	35,000	111-C-01	RWV1-J
C41	35	550	2	20	60,000	111-C-02	RWV1-K
C42	75	1,100	6	20	100,000	111-C-03	—
C43	100	1,000	1	20	100,000	111-C-04	RWV1-L
C44	150	1,200	1	20	100,000	111-C-05	RWV1-M
C45	200	2,200	2	20	150,000	111-C-06	—
C46	220	2,000	2	20	200,000	111-C-07	RWV1-N
C47	300	2,800	3	20	250,000	111-C-08	RWV1-P

VITREOUS ENAMELLED WIRE WOUND RESISTORS

PATTERN C.



The terminal collars are of nickel plated gilding metal. Electrical connections may be secured by the 6BA nuts and bolts or may be made directly to the mounting clips.

Standard clips are available for mounting this pattern of resistor and details are given on page 14, together with the recommended fixing centres. The resistors should be mounted vertically if possible to allow free passage of air through the bore of the tube.

Resistors can be supplied in any value at the appropriate tolerance in the ranges tabled opposite. Resistors to a closer tolerance can be made to special order.

The ratings quoted in the table are based on the permissible dissipation when operating in free air at a temperature of 20°C ; operation at these ratings will result in a surface temperature of approximately 400°C. For applications at high ambient temperatures, some derating will apply — see paragraph 17, page 3.

The reduction in rating of units which have a resistance near the extremes of the range is shown on the graphs opposite — paragraph 18, page 3 refers.

The resistors can be supplied with one or more tapping points depending on the size. Details are given on page 18.

The ranges of non-inductively wound resistors of this pattern are given on page 19.

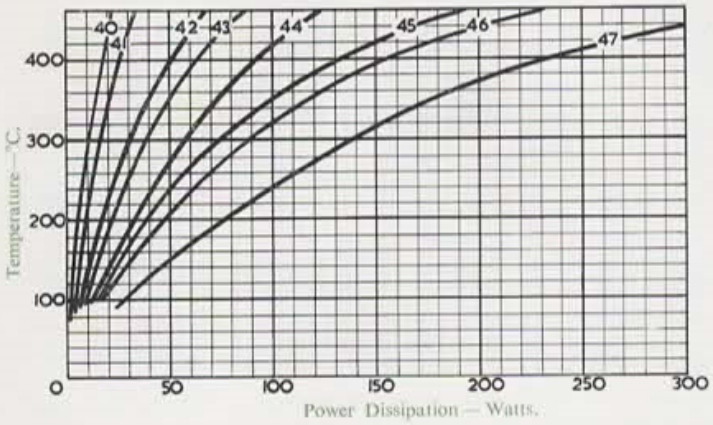
Similar components can be manufactured on which the collars are used for mounting purposes only and have no electrical connection. The electrical connection is made by lengths of tinned copper flex. The pattern is referred to as CP and is illustrated on the back cover.

When ordering the standard component, specify by the type, resistance and tolerance ; for example C42/380Ω ± 5%.

DIMENSIONS

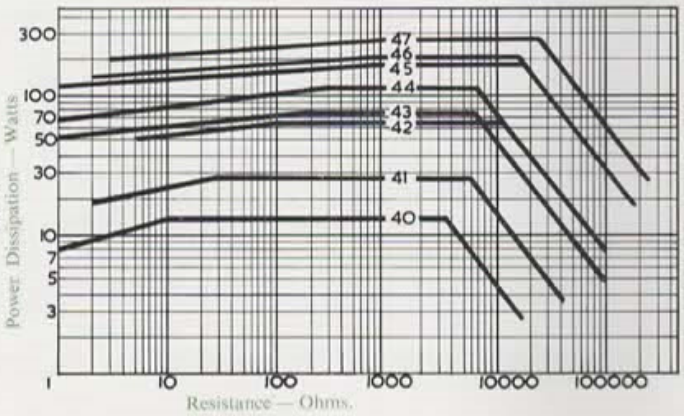
Type	*Rating (Watts)*	*Dimensions (Inches)*					*Weight (grms.)*	*I.S.S.C. Style*
		L	D	A	C	(Max) E		
C40	18	2 5/16	5/8	1/2	9/16	5/8	23	RWV1-J
C41	35	3	5/8	1/2	9/16	5/8	28	RWV1-K
C42	75	5	5/8	1/2	9/16	5/8	40	—
C43	100	4 3/4	7/8	5/8	15/16	3/4	95	RWV1-L
C44	150	5 1/4	1 1/8	5/8	1 1/16	15/16	135	RWV1-M
C45	200	7 3/4	7/8	5/8	13/16	3/4	135	—
C46	220	7 1/4	1 1/8	5/8	1 1/16	15/16	190	RWV1-N
C47	300	9 3/4	1 1/8	5/8	1 1/16	15/16	250	RWV1-P

VITREOUS ENAMELLED WIRE WOUND RESISTORS
PATTERNS AP AND B



Variation of maximum surface temperature with power dissipation (see paragraph 17, page 3).

Variation of permissible dissipation with resistance (see paragraph 18, page 3).



RANGE OF RESISTANCE VALUES

Type	*Rating (Watts)*	*Maximum Continuous Voltage*	*Range (Ohms)*			*R.I.C. Pattern Number*
			Min. at ±10%	*Min. at ± 5%*	*Maximum*	
AP40, B40	12	200	0.5	40	15,000	111-B-11, 111-B-01
AP41, B41	27	400	2	20	43,000	111-B-12, 111-B-02
AP42, B42	65	900	5	20	100,000	111-B-13, 111-B-03
AP43, B43	75	700	1	20	100,000	111-B-14, 111-B-04
AP44, B44	115	900	1	20	100,000	111-B-15, 111-B-05
AP45, B45	180	1,800	1	20	160,000	111-B-16, 111-B-06
AP46, B46	200	1,800	2	20	180,000	111-B-17, 111-B-07
AP47, B47	280	2,500	3	20	250,000	111-B-18, 111-B-08

VITREOUS ENAMELLED WIRE WOUND RESISTORS

PATTERNS AP AND B.

Fig. 1

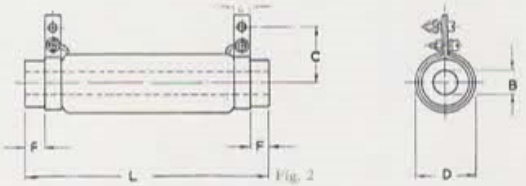


Fig. 2

On pattern AP (fig. 1), the terminals consist of lengths of tinned copper flex, which are held in grooves in the tube preventing any force due to movement of the terminals being transmitted to the resistive element. The standard flex for types AP 40, AP 41 and AP 42 is 28/.0076 and for the remaining types 46/.0076 ; the length is 5 inches.

On pattern B (fig. 2), the terminals consist of nickel plated G.M. bands. These can be provided with 6 BA nuts and bolts for the wiring connections as shown, or with the ends tinned for making soldered connection.

For the catalogue ratings to apply, these resistors should be mounted vertically allowing free passage of air through the bore. Mounting may be effected by means of patterns F, H, K or W brackets or clips. Details of these, together with fixing centres are given on pages 15 to 17.

The ratings refer to use in free air at 20°C. and give a surface temperature of approximately 400°C. For operation at higher ambient temperatures, some derating will apply—see paragraph 17, page 3.

The reduction in rating of units which have a resistance near the extremes of the range is shown on the graphs opposite—paragraph 18, page 3 refers.

Details of tapped resistors and non-inductive resistors of these patterns are given on pages 18 and 19.

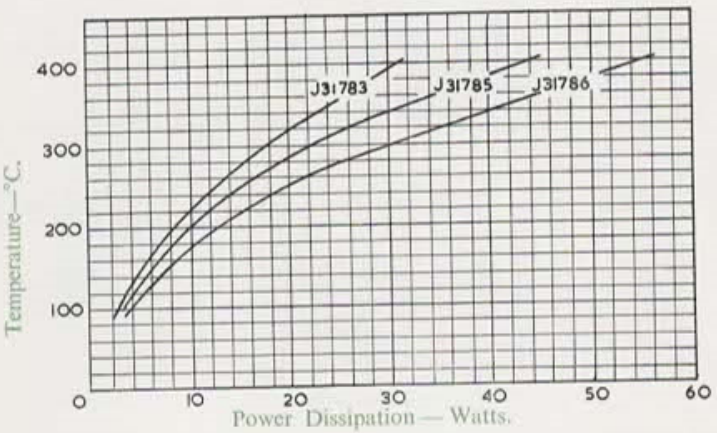
Resistors can be supplied in any value at the appropriate tolerance in the ranges tabled opposite. When ordering, resistors should be specified by type, resistance and tolerance ; for example, AP 44/3,500 Ω ±5%. For pattern B, the terminal connections should be indicated, *i.e.* for soldered or screwed connection.

DIMENSIONS

Type	*Rating (Watts)*	*Dimensions (Inches)*							*Weight (Grms)*
		L	*D*	*B*	*A (Min.)*	*C*	*E*	*F (Min.)*	
AP40, B40	12	1 5/16	5/8	5/16	1/8	11/16	3/16	1/16	17
AP41, B41	27	2	5/8	5/16	1/8	11/16	3/16	1/16	20
AP42, B42	65	4	5/8	5/16	1/8	11/16	3/16	1/16	35
AP43, B43	75	3 1/2	7/8	3/8	1/4	13/16	1/4	3/16	70
AP44, B44	115	4	1 1/8	5/8	1/4	1 1/8	1/4	3/16	105
AP45, B45	180	6 1/2	7/8	3/8	1/4	13/16	1/4	3/16	125
AP46, B46	200	6	1 1/8	5/8	1/4	1 1/8	1/4	3/16	170
AP47, B47	280	8 1/2	1 1/8	5/8	1/4	1 1/8	1/4	3/16	210

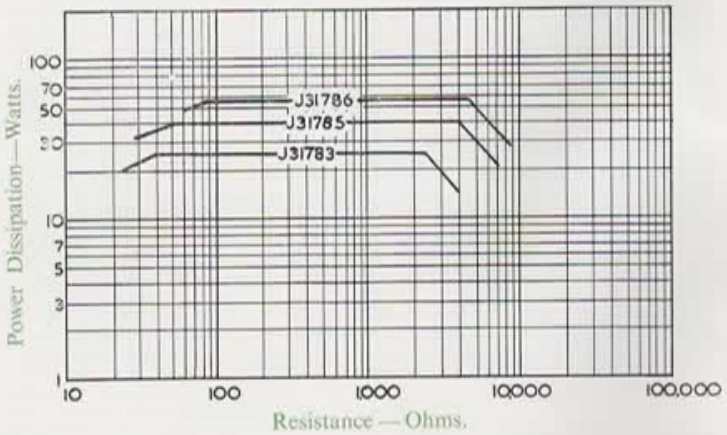
VITREOUS ENAMELLED WIRE WOUND RESISTORS

ELLIPTICAL PATTERNS J AND P



Variation of Maximum surface temperature with power dissipation (see paragraph 17, page 3).

Variation of permissible dissipation with resistance (see paragraph 18, page 3).



RANGE OF RESISTANCE VALUES

Type	*Rating (Watts)*	*Maximum Continuous Voltage*	*Range (Ohms)*		
			Min. at ±10%	*Min. at ±5%*	*Maximum*
J31783	25	250	25	250	4,000
J31785	40	400	30	320	6,500
J31786	55	500	60	550	9,000

VITREOUS ENAMELLED WIRE WOUND RESISTORS

ELLIPTICAL PATTERNS J AND P

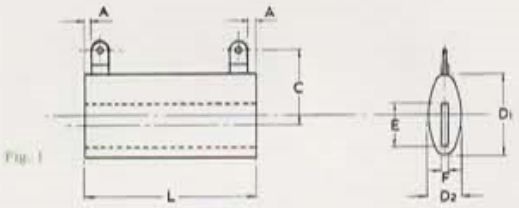


Fig. 1

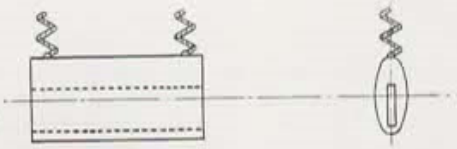


Fig. 2

On elliptical resistors, pattern J (fig. 1), the terminals consist of soldering tags which are securely anchored in the ceramic former. On pattern P (fig. 2), the terminations are lengths of tinned copper flex 28/.0076 cut to customer's requirements.

Resistors can be supplied in any value at the appropriate tolerance in the ranges tabled opposite.

The ratings quoted in the tables are based on the permissible dissipation when operating in free air at a temperature of 20°C ; operation at this rating produces a surface temperature of approximately 400°C. By mounting the component on a suitable heat conducting bracket passing through the bore of the resistor, some measure of uprating may be allowed provided the surface temperature is held to the above figure. For operation at a higher ambient temperature, some derating will apply—see paragraph 17, page 3.

The reduction in rating of units which have a resistance near the extreme of the range is shown on the graphs opposite—paragraph 18, page 3 refers.

When ordering, resistors should be specified by type, resistance, and tolerance, for example J31783/1300Ω ±5%.

DIMENSIONS

Type	*Rating (Watts)*	*Dimensions (Inches)*						
		L	D1	D2	A (*min.*)	C	E	F
J31783	25	$1\frac{1}{4}$	$1\frac{1}{8}$	$\frac{1}{2}$	$\frac{1}{16}$	$\frac{31}{32}$	$\frac{33}{64}$	$\frac{5}{64}$
J31785	40	$1\frac{5}{8}$	$1\frac{1}{8}$	$\frac{1}{2}$	$\frac{1}{16}$	$\frac{31}{32}$	$\frac{33}{64}$	$\frac{5}{64}$
J31786	55	2	$1\frac{1}{8}$	$\frac{1}{2}$	$\frac{1}{16}$	$\frac{31}{32}$	$\frac{33}{64}$	$\frac{5}{64}$

VITREOUS ENAMELLED WIRE WOUND RESISTORS

MOUNTING CLIPS FOR PATTERN C RESISTORS

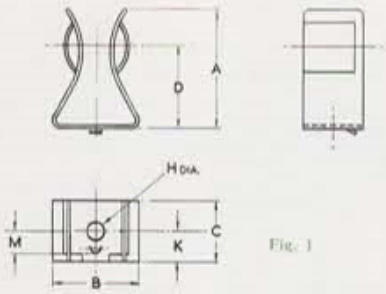


Fig. 1

Fig. 2

These clips are manufactured in sizes to suit the resistors of the three standard diameters listed on pages 8 and 9. They are of nickel plated phosphor bronze and will grip the resistor collars securely and maintain good electrical contact. The resistor is held clear of the surface on which the clips are mounted allowing the vitreous enamel temperature to be 400°C without damage to the surface. Two sizes of clips are available for the resistors with collar diameters $1\frac{1}{16}$ inch.

Each size of clip, except No. 3, is provided with a tag which may be used to locate the clip and prevent rotation.

DIMENSIONS (Inches)

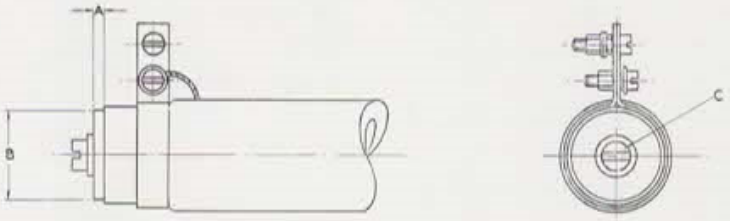
Reference Number	A	B	C	D	H	K	M	*I.S.S.C. Reference*
1	$1\frac{1}{8}$	$\frac{11}{16}$	$\frac{9}{16}$	$\frac{3}{4}$	$\frac{5}{32}$	$\frac{9}{32}$	$\frac{15}{64}$	CL5
2	$1\frac{3}{8}$	1	$\frac{11}{16}$	$\frac{7}{8}$	$\frac{5}{16}$	$\frac{11}{32}$	$\frac{17}{64}$	CL3
3	$1\frac{5}{16}$	$1\frac{1}{16}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{1}{4}$	$\frac{3}{8}$	—	—
4	$1\frac{7}{8}$	$1\frac{1}{4}$	$\frac{3}{4}$	$1\frac{1}{4}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{19}{64}$	CL4

MOUNTING DETAILS

Resistor Type	C40	C41	C42	C43	C44	C45	C46	C47
Clip Reference Number	1	1	1	2	3 or 4	2	3 or 4	3 or 4
Fixing Centres G (Inches)	2	$2\frac{11}{16}$	$4\frac{11}{16}$	$4\frac{5}{16}$	$4\frac{13}{16}$	$7\frac{5}{16}$	$6\frac{13}{16}$	$9\frac{5}{16}$
Clearance F (Inches)	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{1}{4}$ (3) $\frac{5}{8}$ (4)	$\frac{3}{8}$	$\frac{1}{4}$ (3) $\frac{5}{8}$ (4)	$\frac{1}{4}$ (3) $\frac{5}{8}$ (4)

VITREOUS ENAMELLED WIRE WOUND RESISTORS

MOUNTING PATTERN F FOR RESISTOR PATTERNS AP AND B



The pattern F mounting, which provides single screw fixing for all sizes of resistor in patterns AP and B, is specified by an addition to the prefix, for example APF 43.

Since the insert prevents circulation of air through the bore, the rating for each size is reduced by approximately 15% giving the values indicated in the table below.

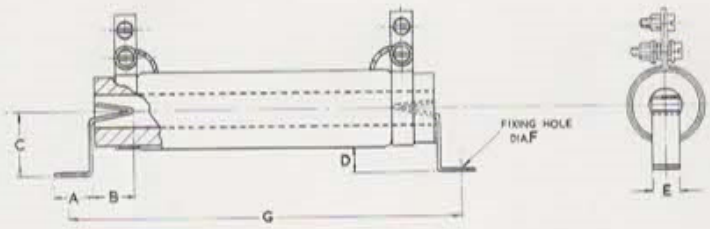
It should be noted that the clearance of the terminals from the mounting surface will be the dimension A added to the dimension A or F quoted on page 11.

DIMENSIONS

Resistor Type	APF 40 BF 40	APF 41 BF 41	APF 42 BF 42	APF 43 BF 43	APF 44 BF 44	APF 45 BF 45	APF 46 BF 46	APF 47 BF 47
A (Inches)	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{1}{8}$
B (Inches)	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{5}{8}$	1	$\frac{5}{8}$	1	1
C	4BA	4BA	4BA	2BA	0BA	2BA	0BA	0BA
Rating (Watts)	10	22	55	64	100	150	170	230

VITREOUS ENAMELLED WIRE WOUND RESISTORS

MOUNTING PATTERN H FOR RESISTOR PATTERNS AP AND B



The pattern H mounting clips are available in three sizes which will accommodate any resistor in the ranges AP and B. The clips are formed from nickel plated brass and are particularly useful in applications where the resistor will be subject to some vibration.

Since this mounting restricts the flow of air through the bore to some extent, the ratings of the larger resistors should be reduced by 10%.

DIMENSIONS (Inches)

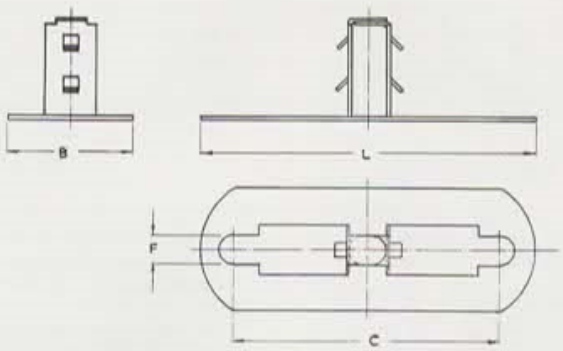
Reference Number	*Material*	A	B	C	E	F
1 H	Nickel Plated Brass 22 S.W.G.	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{1}{4}$	$\frac{1}{8}$
2 H	Nickel Plated Brass 21 S.W.G.	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{11}{16}$	$\frac{5}{16}$	$\frac{5}{32}$
3 H	Nickel Plated Brass 20 S.W.G.	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{13}{16}$	$\frac{7}{16}$	$\frac{3}{16}$

MOUNTING DETAILS

Resistor Type	AP 40 B 40	AP 41 B 41	AP 42 B 42	AP 43 B 43	AP 44 B 44	AP 45 B 45	AP 46 B 46	AP 47 B 47
Clip Reference Numbers	1 H	1 H	1 H	2 H	3 H	2 H	3 H	3 H
Fixing Centres G (Inches)	$1\frac{7}{8}$	$2\frac{9}{16}$	$4\frac{9}{16}$	$4\frac{1}{16}$	$4\frac{11}{16}$	$7\frac{1}{16}$	$6\frac{11}{16}$	$9\frac{3}{16}$
Clearance D (Inches)	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$

VITREOUS ENAMELLED WIRE WOUND RESISTORS

MOUNTING PATTERNS W AND K FOR RESISTOR PATTERNS AP AND B



The pattern W mounting bracket is available in two sizes which are suitable for securing resistors having bore diameters of $\frac{6}{16}$" and $\frac{8}{8}$", *i.e.*, resistors having external diameters of $\frac{5}{8}$" and $\frac{7}{8}$".

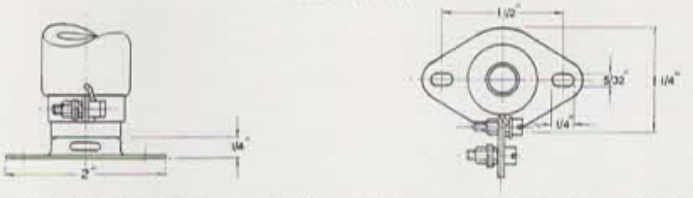
The mounting is intended to hold the resistor in a vertical position and is proof against shock and vibration. For resistors of $\frac{5}{8}$" diameter, the bracket fixing holes correspond with those of a B8A valveholder and for resistors of $\frac{7}{8}$" diameter, with a standard octal valveholder. After attaching the bracket to a chassis, the resistor is pushed home over it, and is held by the steel claws such that it can only be removed by rotating on its axis.

If a suitable hole is provided beneath the bore of the tube, the resistor may be operated at its full rating. If the flow of air is obstructed, the dissipation should be reduced by 15%.

DIMENSIONS (Inches)

Reference Number	*Diameter of Resistor*	L	B	C	F
W 1	$\frac{5}{8}$	$1\frac{5}{8}$	$\frac{9}{16}$	$1\frac{1}{8}$	$\frac{1}{8}$
W 2	$\frac{7}{8}$	2	$\frac{3}{4}$	$1\frac{1}{2}$	$\frac{3}{32}$

PATTERN "K"

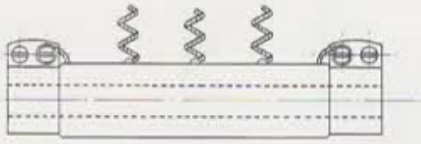


This mounting bracket can be supplied on resistors of patterns AP or B which have an external diameter of $\frac{7}{8}$". It is specified by the prefix, for example BK 45.

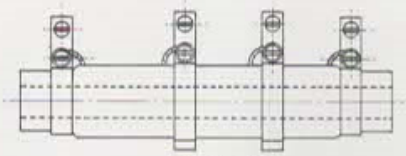
It is intended to allow vertical mounting above a chassis and the fixing holes conform to those of a standard octal valveholder. If a standard valve cut out is provided in the chassis allowing circulation of air through the bore, no reduction in rating is necessary. If the bore is obstructed, the rating should be reduced by 15%.

VITREOUS ENAMELLED WIRE WOUND RESISTORS

TAPPED RESISTORS



Pattern CTP



Pattern BTB

Tapping points can be provided on all types of vitreous enamelled wire wound resistors except on the AW3101 and AW3115.

The connections for the tapping points can most satisfactorily be made to a band type of terminal or to a pigtail (patterns B or P). The bands are similar to the terminals detailed on page 10; the lengths of the pigtails are provided to customers' requirements.

Since the effective winding length of the tapped resistor is shorter, the maximum resistance available in a given size will be less than that listed against the resistor on the preceding pages, and it will vary with the number of tappings. For the same reason, the rating of a resistor with a number of tapping points will be somewhat lower than that of the untapped component when the same maximum surface temperature is permitted. The recommended ratings, which are dependent on each section of the resistor dissipating power in proportion to the length of the section, are tabled below.

Two or more separate resistors may be wound on the same former by leaving a "dead" section between the windings.

The inclusion of the letter T in the prefix indicates a tapped unit and the types of terminals are specified by the remaining prefix letter; thus the type CTP 45 has the end terminals consisting of collars and the intermediate terminals of pigtails; type BTB 45 has both the end and intermediate terminals consisting of bands.

When ordering, the loading of each section should be specified by the current or the wattage; thus—BTB45/100 Ω + 300 Ω + 250 Ω ± 5% 0.4 amps., or BTB45 100 Ω (16 W) + 300 Ω (48 W) + 250 Ω (40 W) ± 5%. The position of a dead section should be indicated by a colon, thus—BTB45/100 Ω (25 W) + 300 Ω (25 W) : 250 Ω (40 W) ± 5%.

RATINGS OF TAPPED RESISTORS (Watts)

Resistor Type	*With One Tapping Point*	*With Two Tapping Points*	*With Three Tapping Points*
BTB 41	20	—	—
BTB 42	58	51	44
BTB 43	61	48	35
BTB 44	100	85	70
BTB 45	167	154	141
BTB 46	185	170	155
BTB 47	165	150	135

Resistor Type	*With One Tapping Point*	*With Two Tapping Points*	*With Three Tapping Points*
CTB 40	11	—	—
CTB 41	28	21	—
CTB 42	68	61	54
CTB 43	187	174	161
CTB 44	135	120	105
CTB 45	192	179	166
CTB 46	200	185	170
CTB 47	285	270	255

VITREOUS ENAMELLED WIRE WOUND RESISTORS
NON-INDUCTIVE TYPES

All patterns and sizes of vitreous enamelled wire wound resistors can be manufactured in a non-inductive form except the miniature component AW3101.

The inductance of a wire wound resistor is reduced to a very low value by employing a type of Ayrton Perry winding. In the form adopted, two similar windings are superimposed on each other and are wound in opposite directions. The close coupling between the two windings results in effective cancellation of the inductance.

Due to the parallel electrical connection of the windings, the maximum value that can be supplied in any particular size is considerably less than that available in the solenoid wound type. The ranges of values and tolerances are listed below.

It is recommended that non-inductively wound resistors should not be operated at ratings in excess of those listed below. This limitation, together with the recommended voltage limitation is to ensure that the voltage between windings and adjacent turns is kept at a low value. The permissible ratings at ambient temperatures other than 20°C. may be assessed from the curves on previous pages — refer to paragraph 17, page 3.

The dimensions and terminal patterns of non-inductive resistors are identical with those of standard types.

When ordering, the non-inductive types should be specified by the addition of the letter L to the prefix, for example AWL3192/500Ω ±5%.

Resistor Type	*Rating at 20°C. (Watts)*	*Maximum Continuous Voltage*	*Range (Ohms)*		
			Min. at ±10%	*Min. at ± 5%*	*Maximum*
AWL 3115	3.5	60	5	35	1,000
AWL 3111	5	140	15	20	4,000
AWL 3112	8	230	20	25	7,000
AWL 3192	18	500	40	40	15,000
AWL 3124	27	700	60	60	20,000
CL 40	11	250	20	20	5,000
CL 41	21	550	50	50	9,000
CL 42	45	1100	120	120	20,000
CL 43	60	1000	150	150	28,000
CL 44	90	1200	200	200	40,000
CL 45	125	2200	300	300	55,000
CL 46	130	2000	350	350	65,000
CL 47	180	2800	500	500	95,000
APL, BL 40	7	175	12	30	4,000
APL, BL 41	16	400	33	40	6,000
APL, BL 42	40	900	100	100	18,500
APL, BL 43	45	700	100	100	19,000
APL, BL 44	70	900	160	160	30,000
APL, BL 45	100	1800	250	250	50,000
APL, BL 46	120	1800	300	300	55,000
APL, BL 47	170	2500	450	450	85,000

Resistors in most of the ranges listed can be supplied to special order wound to give low distributed capacitance.

SECTION 2

PRESET VITREOUS ENAMELLED WIRE WOUND RESISTORS

WELWYN ELECTRICAL LABORATORIES LIMITED

SECTION 3

CEMENT PROTECTED WIRE WOUND RESISTORS

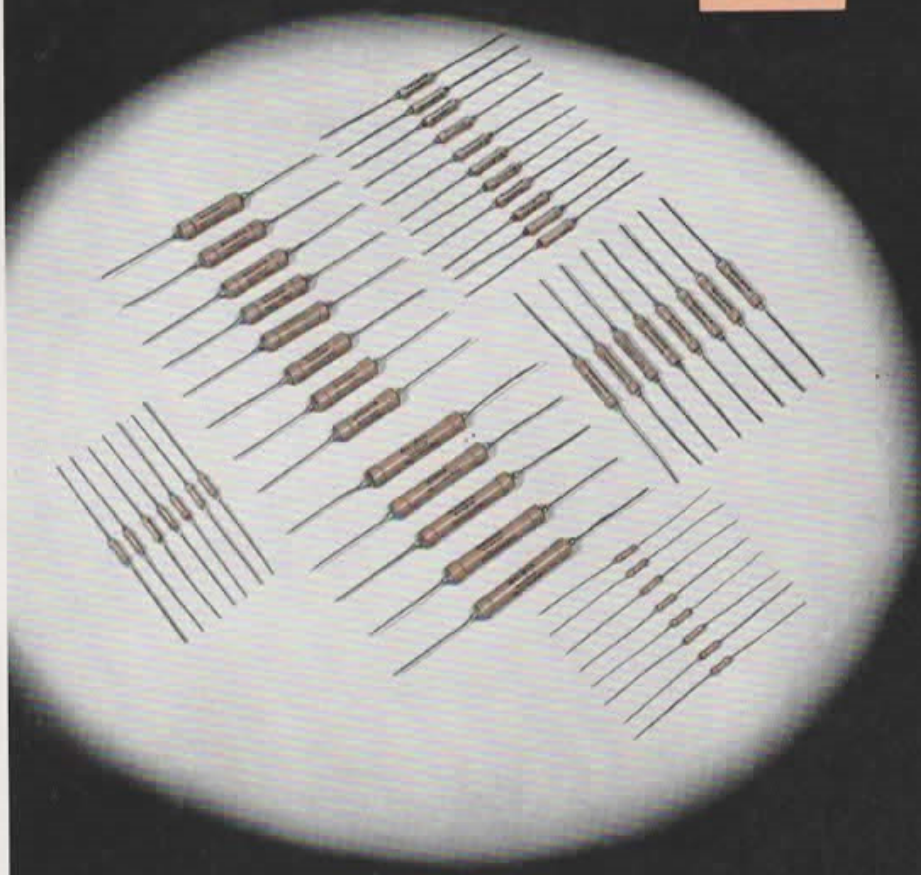
WELWYN ELECTRICAL LABORATORIES LIMITED

SECTION 4

HIGH STABILITY CARBON RESISTORS

WELWYN ELECTRICAL LABORATORIES LIMITED

High Stability Carbon Resistors



INFORMATION AND PAMPHLETS ON OTHER WELWYN PRODUCTS AVAILABLE ON REQUEST

PANCLIMATIC RESISTORS

The Silicone protected range of High Stability Carbon Resistors is being superseded by the Panclimatic range, which gives an improved performance, particularly in the higher values. The Panclimatic range employs a new protective lacquer giving greater stability and other advantages as follows :—

The protective lacquer is hard, giving greater robustness.

An insulating sleeving may be employed without detracting from the performance.

The resistors will withstand temperatures down to — 60°C.

The components may be potted in low temperature moulding resins.

The body colour of the Panclimatic Resistors is black and the marking is in salmon pink.

The equivalent designations of the Panclimatic and Silicone protected Resistors are given below :—

C20	SA3601	$\frac{1}{8}$ Watt
C21	SA3611	$\frac{1}{4}$ Watt
C22	SA3622	$\frac{1}{2}$ Watt
C23	SA3623	$\frac{3}{4}$ Watt
C24	SA3634	1 Watt
C25	SA3635	2 Watts

HIGH STABILITY CARBON RESISTORS

1. The cracking of carbon from organic materials, under certain controlled conditions, yields a highly resistive element which has a number of desirable features in resistor performance. The process applied to ceramic rods results in a wide range of basic resistivities and enables components to be produced in values of a few ohms up to 10^{12} ohms.

2. High Stability Carbon resistors, which are also known as Grade 1 Composition resistors, have been developed from such a process. The manufacturing techniques have been improved over a number of years and the resulting products have benefited from the continual development.

3. These resistors find extensive application in electronic equipments where the accuracy and stability of the circuits depend to a large extent on resistors. The process allows most values in the ranges to be made to a very close tolerance and the components are widely used in electrical meters where the high resistance values required can not be obtained in a conveniently small size of wirewound component.

4. Since the capacitance and inductance are low, high stability carbon resistors are particularly useful for A.C. applications. The components are used effectively at radio frequencies and give an impedance substantially the same as the D.C. resistance. Modified types are available for very high frequencies.

CONSTRUCTION

5. The high stability carbon element is deposited on selected high grade ceramic rods. Turned brass caps, of dimensions matched to the rod diameter, are forced on and provide anchorage for the terminal wires, which are subsequently fixed. The fitting of the caps is such as to ensure that the components will withstand a severe axial pull and that no loosening occurs after repeated heating and cooling of the resistor. A low resistance material intermediate between the caps and the resistive element ensures good electrical contact and a low noise level.

6. Terminal wires of tinned copper are crimped into the caps giving a sound mechanical joint and are then soldered to provide satisfactory electrical continuity. The crimping ensures that the wire will not become detached if a soldering iron is applied close to the cap.

7. The process of bringing the resistance to the required value, which is carried out by cutting a helical groove at a calculated pitch through the carbon film, is such as to allow manufacture to a close tolerance.

8. The resistors are protected by a covering of a high temperature lacquer which permits continuous operation at a surface temperature of 150°C. with a margin of safety, and also enables the component to withstand extremely low temperatures. The lacquer affords good protection against moisture and the components are classed as fully tropical.

SELECTION OF SIZE OF RESISTOR

9. In determining the size of resistor for a particular application, consideration must be given to the dissipation and the ambient temperature, the resistance value and the tolerance required. The maximum surface temperature of the resistor, which should not exceed 150°C., is given by the temperature rise due to the dissipation of energy added to the operating ambient temperature.

10. The temperature rise of the resistor depends to some extent on the amount of heat conducted away through the terminal wires and the approximate values for units dissipating the nominal wattage in free air are given in the table below. The temperature rise for a given size is approximately in proportion to the dissipation; thus, Type SA3635 when dissipating 1 watt will have a temperature rise of 40°C. at the hottest point. A size of resistor should be selected such that its surface temperatures does not exceed 150°C. or any lower figure which may be set as the maximum for the equipment. Diagram 4 on page 6 indicates the recommended maximum dissipation for each unit.

11. It should be ensured that the resistance value and tolerance required are available in the size selected by referring to the table on page 7.

12. To obviate excessive voltage stress between convolutions of the helical track, a voltage limitation is placed on each size of resistor. On the higher resistance values, this leads to a limitation of the dissipation. The derating on this account is shown in diagram 5.

PROPERTIES

13. Slight changes in the resistance of high stability carbon resistors may occur during their life and the magnitude of these changes is indicated in the diagrams on page 4. These diagrams give the largest variations to be expected under different operating conditions and the majority of components will be found to have a substantially smaller drift. The curves illustrate the results of tests on large numbers of resistors and represent a 99% probability.

Resistor Type	SA3601	SA3611	SA3622	SA3623	SA3634	SA3635
Nominal Rating (Watts)	1/8	1/4	1/2	3/4	1	2
Temperature Rise (°C.)	25	40	50	65	50	80

HIGH STABILITY CARBON RESISTORS

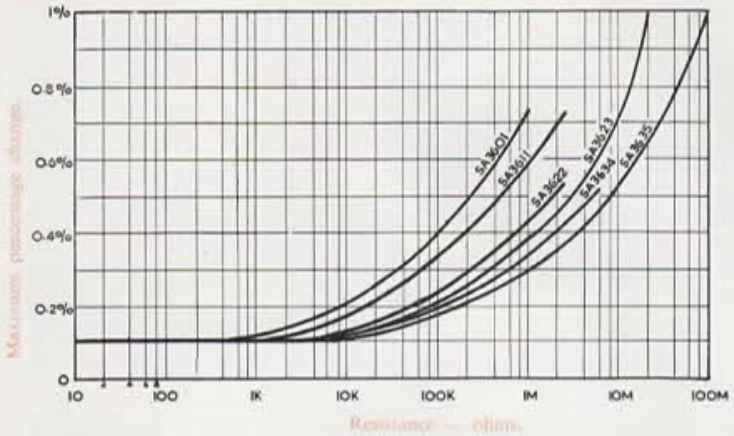


Diagram 1. Maximum change in resistance due to ageing — paragraph 19.

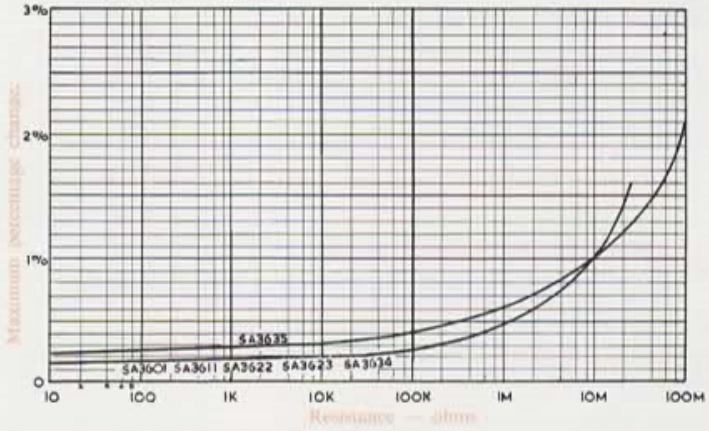


Diagram 2. Maximum change in resistance due to 1,000 hours load — paragraph 20.

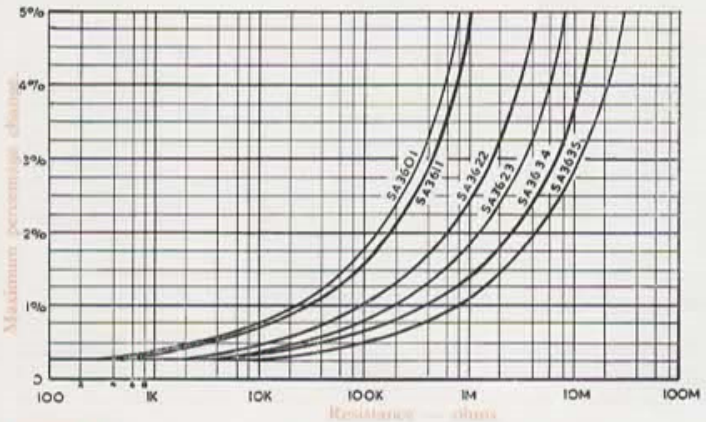


Diagram 3. Maximum change in resistance due to tropical conditions—paragraph 22.

HIGH STABILITY CARBON RESISTORS

14. It will be seen that, under each of the conditions considered, the performance of the lower resistance values is superior to that of the higher values, and that for a given resistance the larger components are more stable.

15. In the ranges of values where the best performance is obtained, the components are offered at an initial tolerance of ±1%. At the extremes of the range the components are only offered at ± 2% or ± 5%. The stability is independent of the manufacturing tolerance and the performance of ±1%, ±2% or ±5% resistors is identical.

16. Any permanent changes in resistance will generally be towards an increased value and Welwyn resistors are made having a value towards the bottom limit, thus ensuring that they will remain within their initial tolerance for the maximum length of time.

17. The standard colour for high stability carbon resistors is salmon pink and the marking is applied in indelible black ink. Resistors are normally marked with the Welwyn designation, the resistance value and the manufactured tolerance, but the marking of Joint Services reference numbers can be incorporated as required.

18. Type approval to the Joint Services specification RCS/112 is held and the components comply with the temperature category 40/100 and the humidity class H-1. The Joint Services designations are given in the table on page 7.

19. AGEING. The maximum drift that may occur with normal factory storage over a period of six months is shown in diagram 1 opposite. If the conditions of storage or use involve extremes of temperature and/or high humidity, the maximum drift will be given by a figure intermediate between those indicated by diagrams 1 and 3.

20. OPERATING STABILITY. Diagram 2 shows the maximum permanent change in resistance when the components dissipate their normal power for a period of 1,000 hours. If resistors dissipate less than their nominal rating, an improved stability will be obtained.

21. The resistance change is largely governed by the maximum surface temperature, and the lower temperature rise (reference paragraph 10) of the five smaller sizes leads to a greater operating stability than that of the SA3635 in the lower resistance values. However, in the higher resistance values, the voltage limitation restricts the dissipation and ensures a lower temperature rise on all sizes. In this higher range, the SA3635, having an element of lower resistivity, will give a better stability than the other sizes.

22. EFFECTS OF MOISTURE. The performance of Welwyn High Stability Carbon resistors under conditions of high humidity is shown in diagram 3. The curves illustrate the maximum variation of resistance which may occur as a result of an accelerated climatic test. The changes largely result from the humid atmosphere treatment which comprises three cycles of sixteen hours at 55°C. with a relative humidity exceeding 95%. Under the tropical exposure tests which consist of 1,000 hours at temperatures fluctuating between 20°C. and 35°C. with a relative humidity exceeding 95%, the maximum changes may be somewhat greater but not by more than a factor of two.

23. TEMPERATURE COEFFICIENT. For all types of film resistors, the temperature coefficient of resistance varies with the film thickness and thus with the resistance value. Welwyn resistors are designed to give as low a temperature coefficient as possible commensurate with satisfactory performance in other respects. The coefficient is negative in all cases: that is, an increase in temperature gives a reduction in resistance. It is found to be substantially linear over the temperature range −40°C. +100°C.

24. Diagram 6 shows the maximum value of temperature coefficient for the range of resistance values of each size. The average component will have a value less than the maximum but not less than 200 parts per million per degree Centigrade, which is the limiting value for cracked carbon.

25. VOLTAGE COEFFICIENT. Since the resistive element of cracked carbon resistors is a homogeneous material, non-linearity of current against applied voltage is negligible. A small change of effective resistance, which is distinct from the change due to temperature coefficient, does occur when a voltage is applied. This can be represented by the voltage coefficient which is of the order of 50 parts per million per volt over most of the range rising to 500 parts per million for the very high values.

26. NOISE. Due to the homogeneous nature of the resistive element, the noise voltage developed across the resistor when operating at its rated wattage is very low. There is present in all conductors the thermal or Johnson noise which may be evaluated from the formula $V = \sqrt{0.25}\ TRF$ when V μ volts is the noise voltage, T° is the absolute temperature, R Megohms is the resistance and F.Kc/s is the bandwidth under consideration. When the components are dissipating their full rated power, the total noise may be a small multiple of the thermal noise.

27. REACTANCE. The reactance of Welwyn High Stability Carbon resistors is low and they may be used effectively over a wide band of frequencies. The self-capacitance and the inductance introduced by the helical resistance element have a modifying effect on the impedance at high frequencies. For operation at frequencies above 10 Mc/s. the difference in the impedance compared with the D.C. measured value may make it desirable for some applications to employ special components. Details of High Stability Carbon resistors for use at very high frequencies will be found in Section 6 of the Welwyn Catalogue.

HIGH STABILITY CARBON RESISTORS

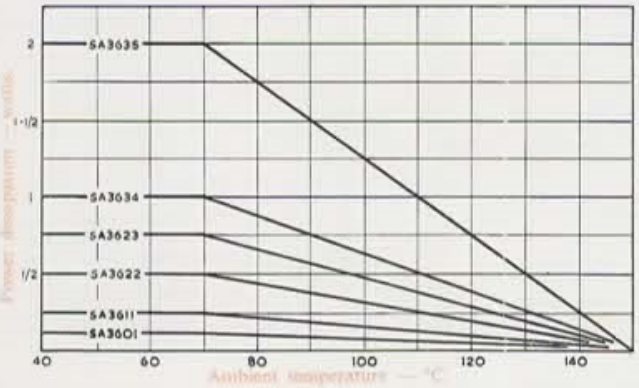


Diagram 4. Variation of maximum permissible power dissipation with ambient temperature — paragraph 10

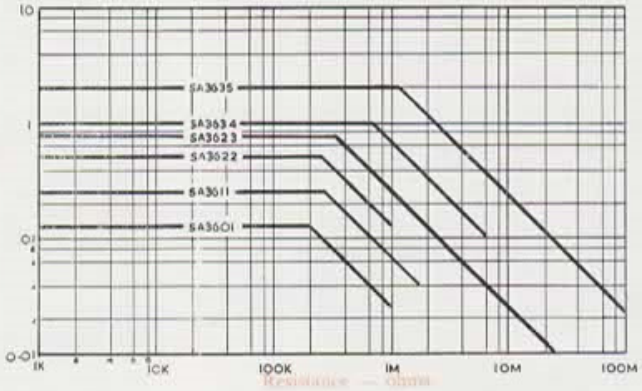


Diagram 5. Variation of maximum permissible power dissipation with resistance — paragraph 12.

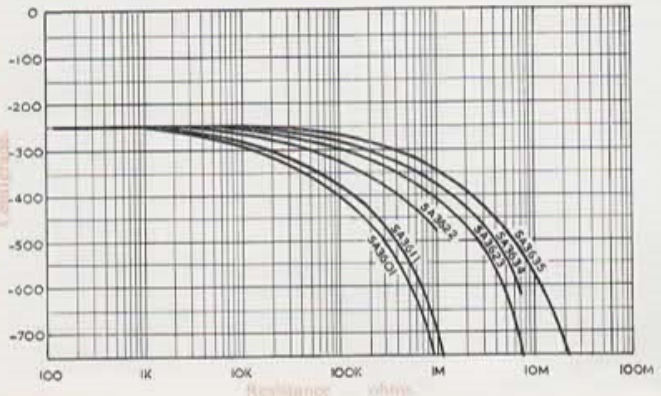


Diagram 6. Variation of maximum temperature coefficient with resistance — paragraph 24.

HIGH STABILITY CARBON RESISTORS

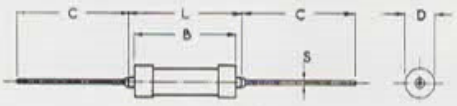


Fig. 1

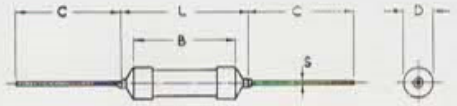


Fig. 2

The terminal wires are tinned copper of a gauge suitable to support the weight of the resistor.

Resistors are manufactured in any value at the appropriate tolerance as indicated in the table below. Resistors of values below 100 Ω can be manufactured to special orders at a tolerance closer than 5%.

When ordering, resistors should be specified by type, resistance and tolerance; for example, SA3611/215 ohm ±1%.

DIMENSIONS

Panclimatic Type	*Silicone Type*	*Rating (watts)*	*Diagram*	*Dimensions (Inches)*					*Approx. Weight (grms.)*	*I.S.S.C. Style*
				L	D	B	C	S		
C20	SA3601	$\frac{1}{8}$	Fig. 1	$\frac{7}{16}$	$\frac{9}{64}$	$\frac{11}{32}$	$1\frac{1}{2}$	26 SWG	$\frac{3}{4}$	—
C21	SA3611	$\frac{1}{4}$	Fig. 2	$\frac{19}{32}$	$\frac{5}{32}$	$\frac{7}{16}$	$1\frac{1}{2}$	21 SWG	1	RC2—E
C22	SA3622	$\frac{1}{2}$	Fig. 2	$\frac{7}{8}$	$\frac{3}{16}$	$\frac{5}{8}$	$1\frac{1}{2}$	20 SWG	2	RC2—D
C23	SA3623	$\frac{3}{4}$	Fig. 2	$1\frac{9}{32}$	$\frac{5}{16}$	$1\frac{1}{32}$	$1\frac{1}{2}$	20 SWG	$2\frac{1}{4}$	RC2—C
C24	SA3634	1	Fig. 2	$1\frac{19}{32}$	$\frac{11}{32}$	$1\frac{7}{32}$	$1\frac{1}{2}$	20 SWG	$6\frac{1}{4}$	RC2—B
C25	SA3635	2	Fig. 2	$2\frac{1}{4}$	$\frac{11}{32}$	$1\frac{7}{8}$	$1\frac{1}{2}$	20 SWG	$7\frac{1}{2}$	RC2—A

RANGE OF RESISTANCE VALUES

Panclimatic Type	*Silicone Type*	*Rating (watts)*	*Maximum Continuous Voltage*	*Range (Ohms)*			*R.I.C. Pattern Number*
				at ±5%	*at* ±2%	*at* ±1%	
C20	SA3601	$\frac{1}{8}$	200	10— 1M	50—500K	100—200K	112-A-01
C21	SA3611	$\frac{1}{4}$	250	10— 5M	50— 2.5M	100—1.5M	112-A-02
C22	SA3622	$\frac{1}{2}$	350	10— 10M	50— 5M	100— 2.5M	112-A-03
C23	SA3623	$\frac{3}{4}$	500	10— 25M	50— 10M	100— 5M	112-A-04
C24	SA3634	1	800	10— 10M	50— 10M	100— 10M	112-A-06
C25	SA3635	2	1500	10—100M	50— 30M	100— 20M	112-A-08

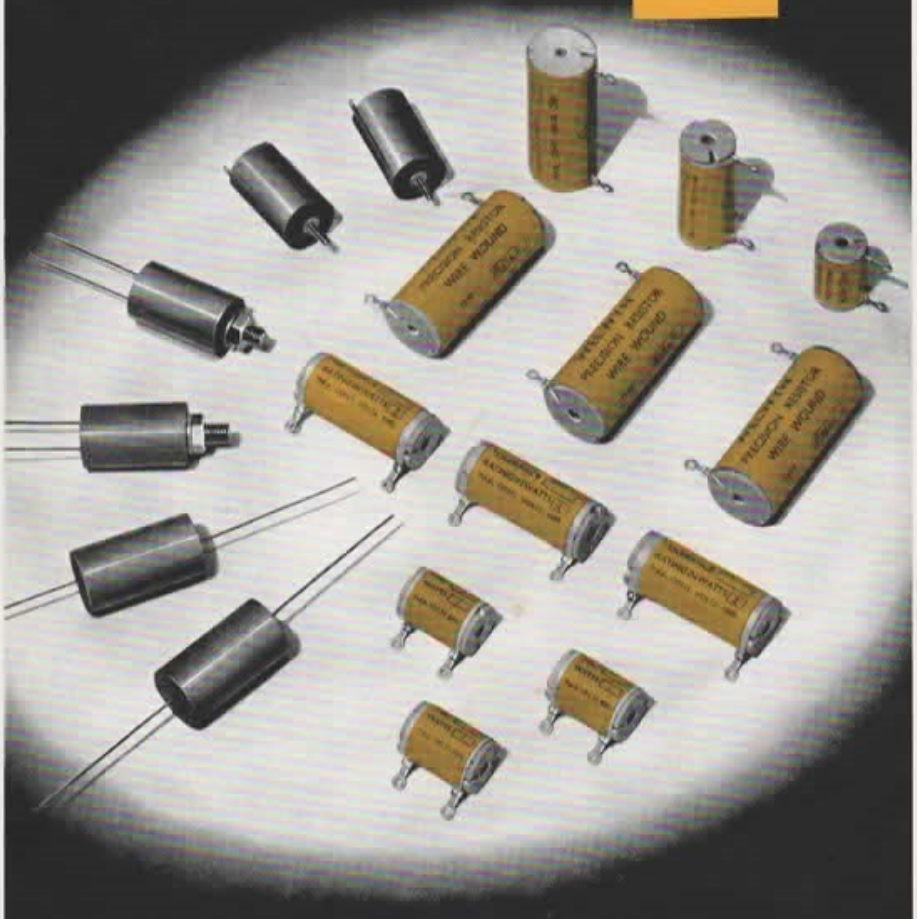
SECTION 5

PRESET POTENTIOMETERS

WIRE WOUND & CARBON COMPOSITION

WELWYN ELECTRICAL LABORATORIES LIMITED

Precision Wire-Wound Resistors



WELWYN ELECTRICAL LABORATORIES LTD.

BEDLINGTON • NORTHUMBERLAND

PHONE: BEDLINGTON 2181 • *GRAMS*: RESISTOR BEDLINGTON

PRECISION WIREWOUND RESISTORS

Precision resistors are required to be supplied to a precise initial value and must have a permanence of resistance within the manufacturing tolerance. The construction of the components must be such that under operating or storage conditions there are no random variations of resistance value either of a permanent or transitory nature. The design of the components should eliminate the possibility of damage through normal handling, while providing adequate protection against tropical conditions.

The ranges described on the following pages have been developed over a number of years, specifically to meet the above requirements, and they incorporate many special features which are the result of extensive experience.

CONSTRUCTION

The resistors comprise enamelled silk covered resistance wire, wound on ceramic formers. The winding technique eliminates the possibility of excessive voltage stress existing between adjacent turns, and the provision of adequate insulation obviates any electrical instability. In order to achieve the extreme reliability necessary in this type, experience has led to the use of enamel and silk covering of the wire. To minimise the distributed self capacitance, the winding length is divided into sections while the direction of winding is frequently reversed in order to keep the inductance to a low value.

When the precise resistance value has been achieved, the resistance element is welded to the end connections, and the component is vacuum impregnated with a suitable lacquer. To remove any stress which might have arisen during manufacture, the resistors are individually stabilised and the stabilising characteristics observed to ensure that the operating performance will be of the required standard.

Finally the tropical types of resistors are encapsulated in an insulating resin and are provided with appropriate terminals.

PERFORMANCE

The stability of these resistors under normal conditions of use is better than the manufactured tolerance. Resistors made to the wider standard tolerances have a stability comparable with those to the closer tolerances.

The types listed on pages 4 to 6 are protected against tropical conditions and meet the requirements of RCS-111.

The types on page 7 are intended for non-tropical applications and for use in sealed equipments.

The temperature coefficient of these resistors is dependent upon the alloy used and the values are listed on the following pages for standard alloys. Resistors of any value up to the maximum for the size will satisfactorily dissipate their rated power, and the magnitude of the random noise generated will not exceed that due to thermal agitation.

The fact that the terminals are securely anchored to the former remote from the resistance element ensures that normal handling will not affect the resistance value of the component.

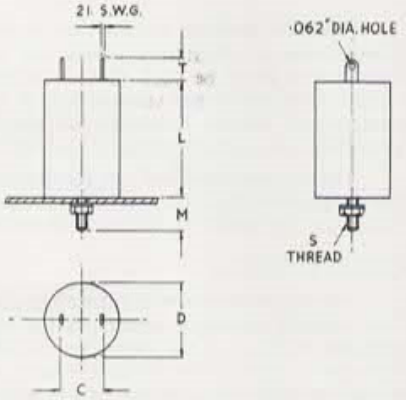
SPECIAL TYPES

A variety of fixing arrangements and terminal facilities are available in the types listed but special requirements can readily be met. Multiple units, including up to ten individual resistors, can be supplied with internal wiring as required.

Non-standard resistance alloys can be used to provide resistors having a lower temperature coefficient than those listed where this is specifically called for.

PRECISION WIRE WOUND RESISTORS

VERTICAL MOUNTING PATTERN



For this pattern, the resistive element is moulded in an insulating resin and the component is provided with a stud for fixing directly to a chassis. A potential of 1,000 volts may be applied between the element and the mounting stud.

The standard resistor is fitted with soldering tag terminals as shown above, but wire terminals 2" long can be provided if required.

The lower values of resistance involve the use of a copper nickel alloy, having a temperature coefficient not greater than ± 20 parts per million per degree Centigrade, and the maximum resistance value obtainable using this alloy is given in the table below. The higher values of resistance are obtained using nickel chromium, having a positive temperature coefficient of approximately 90 p.p.m. per °C. A special alloy having a temperature coefficient not exceeding 20 p.p.m. per °C can be supplied to special order.

The standard tolerances are ± 0.1%, ± 0.5%, ±1% and ± 2%, though other tolerances may be supplied to special order. Values below 50Ω are supplied to a closest tolerance of ± 0.5%. The resistors can be manufactured to any value in the range shown in the table. The maximum loading may be safely applied to all values in the range.

The temperature rise of the element when operated at the nominal rating is approximately 40°C. It is recommended that the maximum temperature due to power dissipation and ambient temperature should not exceed 120°C.

This range is fully tropicalised, and the resistors meet the requirements of Specification RCS/111 with a greatly improved stability of resistance value.

When ordering, resistors should be specified by the type, resistance and tolerance, for example, B93/605K ± 0.1%.

Type	*Rating (Watts)*	*Dimensions (Inches)*						*Range of Values (Ohms)*	*Max. Value (Ohms) using Cu.Ni.*
		L	*D*	*M*	*C*	*T*	*S*		
B91	½	1	7/16	3/8	½	¼	6BA	1 to 200K	8.5K
B92	1	1 3/8	7/16	3/8	½	¼	6BA	1 to 400K	17 K
B93	2	2¼	1	3/8	½	¼	6BA	2 to 1M	46 K
B94	3	2⅝	1 1/8	½	¾	¼	2BA	3 to 2M	86 K

PRECISION WIRE WOUND RESISTORS

AXIAL LEAD PATTERN

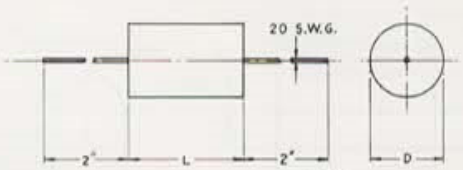


Fig. 1

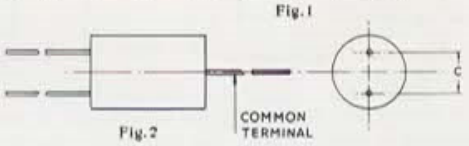


Fig. 2

These resistors are encapsulated in an insulating resin, which gives full protection against tropical conditions. The arrangement of the terminal wires is such that soldering at any point will not affect resistance value.

The lower values of resistance involve the use of a copper nickel alloy, having a temperature coefficient not greater than ± 20 parts per million per degree Centigrade, and the maximum resistance value obtainable using this alloy is given in the table below. The higher values of resistance are obtained using nickel chromium, having a positive temperature coefficient of approximately 90 p.p.m. per °C. A special alloy having a temperature coefficient not exceeding 20 p.p.m. per °C can be supplied to special order.

The temperature rise of the element when operated at the nominal rating is approximately 40°C. It is recommended that the maximum temperature due to power dissipation and ambient temperature should not exceed 120°C.

The standard tolerances are ± 0.1%, ± 0.5%, ± 1% and ± 2%, though other tolerances may be supplied to special order. Values below 50 Ω are supplied to a closest tolerance of ± 0.5%. The resistors can be manufactured to any value in the range shown in the table. The maximum loading may be safely applied to all values in the range.

Figure 2 shows the terminal arrangements for two section resistors. The sum of the values of the two sections can not exceed the maximum shown for the appropriate size in the table below. The closest tolerance of individual values is ± 1%, although on the two largest sizes the sections can be matched to ± 0.5%. Type B30 can only be supplied as a single section resistor.

When ordering, resistors should be specified by the type, resistance and tolerance, for example B31/1685 Ω ± 0.1%, or for two section resistors, B33/100K + 50K ± 1%.

Type	*Rating (Watts)*	*Dimensions (Inches)*			*Range of Values (Ohms)*	*Max. Value (Ohms) using Cu.Ni.*
		L	*D*	*C*		
B30	$\frac{1}{4}$	$1\frac{1}{16}$	$\frac{11}{32}$	—	1 to 50K	2.1K
B31	$\frac{1}{2}$	1	$\frac{7}{16}$	$\frac{1}{2}$	1 to 200K	8.5K
B32	1	$1\frac{3}{16}$	$\frac{7}{8}$	$\frac{1}{2}$	1 to 400K	17 K
B33	2	$2\frac{1}{8}$	1	$\frac{1}{2}$	2 to 1M	46 K
B34	3	$2\frac{3}{8}$	$1\frac{1}{8}$	$\frac{3}{4}$	3 to 2M	86 K

PRECISION WIRE WOUND RESISTORS

FERRULE TERMINAL PATTERN

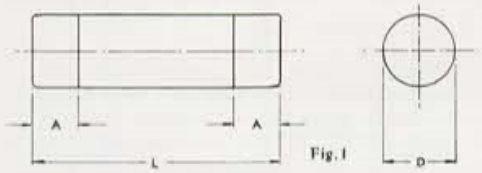


Fig. 1

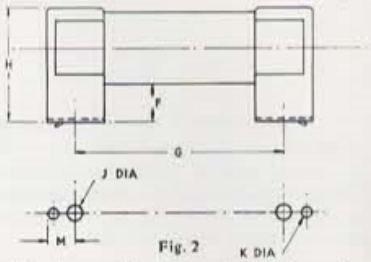


Fig. 2

This range of precision resistors is particularly suitable for applications where the value of the resistor is required to be changed from time to time. When fixed in the clips, the resistor is securely held, and will not be displaced by shock or vibration.

The resin protection prevents any deterioration of the resistor under tropical conditions, and the units meet the requirements of RCS/111, with a greatly improved stability of resistance value.

The lower values of resistance involve the use of a copper nickel alloy, having a temperature coefficient not greater than ± 20 parts per million per degree Centigrade, and the maximum resistance value obtainable using this alloy is given in the table below. The higher values of resistance are obtained using nickel chromium, having a positive temperature coefficient of approximately 90 p.p.m. per °C. A special alloy having a temperature coefficient not exceeding 20 p.p.m. per °C can be supplied to special order.

The standard tolerances are ± 0.1%, ± 0.5%, ± 1% and ±2%, though other tolerances may be supplied to special order. Values below 50Ω are supplied to a closest tolerance of ± 0.5%. The resistors can be manufactured to any value in the range shown in the table. The maximum loading may be safely applied to all values in the range.

The temperature rise of the element when operated at the nominal rating is approximately 35°C. It is recommended that the maximum temperature due to power dissipation and ambient temperature should not exceed 120°C.

When ordering, resistors should be specified by the type, resistance and tolerance, for example, B86/1M ± 0.5%.

Type	*Rating (Watts)*	*Dimensions (Inches)*			*Range of Values (Ohms)*	*Max. Value (Ohms) using Cu.Ni.*
		L	*D*	*A*		
B86	1	1 3/4	7/8	7/16	1 to 1M	40K
B87	2	3	1 1/8	9/16	2 to 2M	80K
B88	3	4 3/8	1 1/8	5/8	3 to 3M	120K

CLIP FIXING DETAILS

Type	*Rating (Watts)*	*Dimensions (Inches)*						*Clip Ref. No.*
		G	*H*	*F*	*J*	*M*	*K*	
B86	1	1 3/8	1 5/8	7/16	5/16	17/64	1/8	2
B87	2	2 3/8	1 5/8	7/16	5/16	17/64	1/8	2
B88	3	4	1 5/8	11/16	1/4	19/64	1/8	4

PRECISION WIRE WOUND RESISTORS

BAND TERMINAL PATTERN

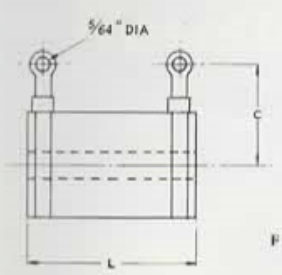
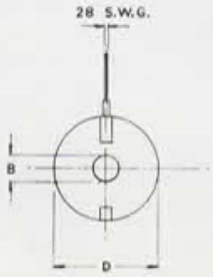


Fig. 1



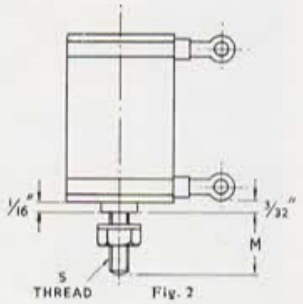


Fig. 2

These precision resistors are manufactured in a similar manner to those described on pages 4-6, but they are not encapsulated in resin. They are provided with robust band terminals which are clamped on the ceramic former remote from the resistance element. A fixing device as shown in figure 2 can be incorporated on all sizes. This enables the resistor to be mounted on a chassis with adequate clearance to the lower soldering tag. This form is designated by the prefix 2, for example, 2B23.

The lower values of resistance involve the use of a copper nickel alloy, having a temperature coefficient not greater than ± 20 parts per million per degree Centigrade, and the maximum resistance value obtainable using this alloy is given in the table below. The higher values of resistance are obtained using nickel chromium, having a positive temperature coefficient of approximately 90 p.p.m. per °C. A special alloy having a temperature coefficient not exceeding 20 p.p.m. per °C can be supplied to special order.

The standard tolerances are ± 0.1%, ± 0.5%, ± 1% and ± 2%, though other tolerances may be supplied to special order. Values below 50Ω are supplied to a closest tolerance of ± 0.5%. The resistors can be manufactured to any value in the range shown in the table. The maximum loading may be safely applied to all values in the range.

The temperature rise of the element when operated at the nominal rating is approximately 40°C. It is recommended that the maximum temperature due to power dissipation and ambient temperature should not exceed 120°C.

When ordering, resistors should be specified by the type, resistance and tolerance for example, B21/100K ± 1%.

Type	*Rating (Watts)*	*Dimensions (Inches)*					*Range of Values (Ohms)*	*Max. Value (Ohms) using Cu.Ni.*
		L	*D*	*B*	*C*	*S*		
B21	½	11/16	5/8	5/32	19/32	6BA	1 to 200K	8.5K
B22	1	1	5/8	5/32	19/32	6BA	1 to 400K	17 K
B23	2	1 3/4	11/16	5/32	5/8	6BA	2 to 1M	46 K
B24	3	2 1/4	7/8	5/32	23/32	2BA	3 to 2M	86 K

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Glasgow.

Overseas Agents :

AUSTRALIA
Messrs. Manufacturers Special Products PTY Ltd.,
47 York Street,
Sydney,
New South Wales.

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Wilhelmsgt, 8.
Oslo.

SWEDEN
Messrs. Gunnar Wiklund, A.B.,
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Stockholm, C.

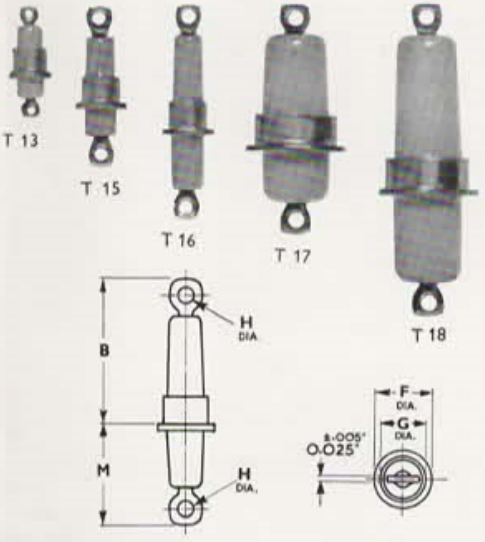
U.S.A.
Messrs. Rockbar Corporation,
215 East 37th Street,
New York 16, N.Y.

Welwyn

SEALED TERMINALS

Improved design features

ACTUAL SIZES



DIMENSIONS IN INCHES

Type No.	Assembly		Collar		Terminals	Recommended Diameter of Fixing Hole
	B. Max.	M. Max.	F.	G.	H.	
T13	0·435	0·280	0·250	0·218	0·195	0·218 +·005 −0
T15	0·650	0·408	0·312	0·250	0·195	0·250 +·005 −0
T16	0·815	0·580	0·312	0·250	0·195	0·250 +·005 −0
T17	0·903	0·565	0·593	0·500	0·195	0·500 +·005 −0
T18	1·135	0·805	0·593	0·500	0·195	0·500 +·005 −0

ELECTRICAL CHARACTERISTICS

Type No.	Max. Current Rating (Amperes)	Peak Working Voltage in Air	Maximum Capacitance at 1 Mc/s(pF)	Maximum Resistance (Ohms)
T13	3	1000	2·5	0·006
T15	5	1500	3·5	0·005
T16	5	3000	4·0	0·006
T17	10	4500	4·5	0·004
T18	10	6500	5·0	0·005

IN COLLABORATION with The Worcester Royal Porcelain Company, we have developed and are now manufacturing a range of sealed terminals which incorporate improved features in the design. These components find wide application for use with transformers, capacitors, chokes, etc, which are with advantage hermetically sealed against moisture and adverse climatic conditions. The range of sizes will cover most requirements and includes terminals for operation at up to 6,500 volts.

The insulators of these components are manufactured from fused aluminium oxide which, as is well known, has great strength and resistance to thermal shock. The conducting lead through the centre is an iron alloy having a coefficient of expansion which matches that of the insulator. This lead is sealed into the insulator by an improved method which avoids any reduction in the cross sectional area of the conductor and thus maintains a low electrical resistance and avoids the formation of a hot spot when the conductor is carrying current. The sealing is effected by a glaze which matches the insulator and the conductor. The assembly will therefore withstand sudden changes of temperature in excess of those likely to be encountered in any application of radio or electronic equipment. The glazed insulator has a high surface insulation and its electrical properties are not impaired at temperatures in excess of 100°C. The components may be used with safety at a very high ambient temperature.

The flanged collar for fixing the terminal to a casing is a driven fit on the slightly tapered surface of the insulator. The pressure is such that metal flow occurs and a completely hermetic seal is obtained. No leakage will occur when a differential pressure of 10 atmospheres exists between the ends. The collar and the terminal connectors are tinned in order to be readily solderable.

Our range is Type Approved to the Joint Services Specification RCS331. This allows them to be used in equipments which are subject to temperatures of —40°C to + 100°C. The equivalent Services and Welwyn designations together with the Joint Services catalogue numbers are set out below.

Joint Services Designations	Welwyn Type Nos.	Joint Services Catalogue Nos.
TLS1-AA	T.13	Z560882
TLS1-BB	T.15	Z560883
TLS1-CC	T.16	Z560884
TLS1-DD	T.17	Z560885
TLS1-EE	T.18	Z560886

MANUFACTURERS OF WELWYN ELECTRICAL COMPONENTS

WELWYN ELECTRICAL LABORATORIES LTD

BEDLINGTON . . . . . NORTHUMBERLAND

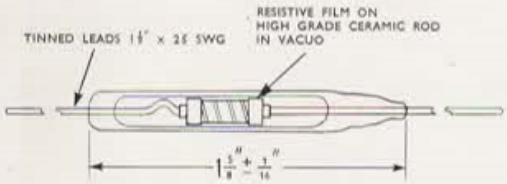
LONDON OFFICE: 55-58 PALL MALL SW1 · *Telephone: Whitehall 0184 · Telegrams: Welistor Piccy*
CANADA : WELWYN CANADA LIMITED · 1255 BRYDGES ST · LONDON · ONTARIO
U.S.A. : WELWYN INTERNATIONAL INC · 3355 EDGECLIFFE TERRACE · CLEVELAND 11 · OHIO
and representatives in Australia and various European Countries

Ref. No. W1006

Welwyn

'WELMEG'

Glass Enclosed High Value Resistors



'WELMEG' resistors were developed in collaboration with the Atomic Energy Research Establishment, primarily for use in instruments employed in nuclear research and associated processes. The development has been highly successful and the properties of the resistor are in general very much better than the target specification that was originally set. These resistors will be found most suitable for use with electrometer valves, ionization chambers and similar devices, and in any position where a high value resistor of close tolerance and good stability is required.

Resistance Range	$2{\cdot}5 \times 10^7\ \Omega$ to $10^{12}\ \Omega$
Tolerance	± 20% and ± 10%
Resistors may be supplied in matched groups to closer tolerances.	
Tolerance to marked value	± 1%
Stability at room temperature	better than 2% per annum
Stability at 100°C	better than 5% per month
Temperature coefficient	less than −0·1% per degree Centigrade
Voltage coefficient	−0·01% per volt to −0·1% per volt depending on resistance
Noise	less than 3 millivolts per volt applied
Maximum working temperature	120°C.
Maximum working voltage	500 Volts DC.

The resistor comprises a high grade, low loss, ceramic tube, upon which is deposited a conducting composition layer. Contact is made at either end by means of turned brass caps carefully dimensioned to give a firm positive grip without damaging the conducting layer or the tube by crushing. The resistance layer is subjected to a stringent ageing procedure and only after it is shown that each tube has a satisfactory performance is it passed for further processing. A helix is then ground through the film, which greatly increases the resistance value and enables an accurate adjustment to value to be made.

This form of construction results in a conductor of relatively low resistivity while the thickness of the conducting layer ensures the maximum reliability and performance. Further, the length of the resistive track results in a good voltage coefficient as the stress per unit length for a given voltage is very much lower than would be the case were the layer unspiralled.

The resistors are vacuum sealed in glass and are then stabilised for a long period. After stabilisation and a most rigorous inspection they are individually checked for temperature coefficient, noise and voltage coefficient and are then stored for a sufficient period to ensure that each resistor is stable.

The glass envelopes are coated with a silicone resin to render the surface immune to the effects of water and they will withstand boiling water without change. In the course of time the silicone may deteriorate and it is then possible to remove it by dissolving in a hydrocarbon and to replace the coating without harming the resistor.

Every resistor is given a serial number, which is marked on the packing slip. The user is advised to note it and to refer to the number in any correspondence so that the history of the unit can be traced.

The 'WELMEG' resistor is a precision component but is rugged and will stand all normal usage with a remarkable stability of resistance value.

WELWYN ELECTRICAL LABORATORIES LTD

BEDLINGTON · · · · · · NORTHUMBERLAND

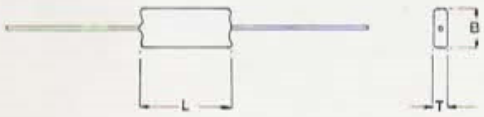
CANADA: WELWYN CANADA LIMITED · 1255 BRYDGES ST · LONDON · ONTARIO
LONDON OFFICE: 55-58 PALL MALL SW1 · *Telephone: Whitehall 0184 · Telegrams: Welistor Piccy*
U.S.A.: ROCKBAR CORPORATION · 211 EAST 37th STREET · NEW YORK 16, N.Y., U.S.A.
and representatives in Australia and various European Countries

Ref No. W1002

81477

Welwyn VITRICON

VITREOUS ENAMELLED CAPACITORS



After extensive research into the application of various dielectric materials, the VITRICON range of miniature capacitors has been developed that employs a dielectric for which the raw materials are available in this country, and that can be closely controlled in its electrical characteristics.

The types which are being manufactured at present are listed below.

When ordering, the designation, value and tolerance should be specified.

DESIGNATION	MAXIMUM DIMENSIONS (Inches) L	B	T	RANGE OF VALUES (pF)
1QD	½	1/16	1/32	18 to 39
1QE	5/8	¼	1/32	above 39 to 91
1QF	11/16	1/16	1/32	,, 91 to 200
1QG	1	1/16	1/32	,, 200 to 430
1QH	1¼	1/16	¼	,, 430 to 1000

Terminals . . . . . 1½" x 22 S.W.G. solder dipped copper wire.

Available tolerances . . . . . ±20%, ±10%, ±5% and ±2% with ±0·5 pF as the closest tolerance.

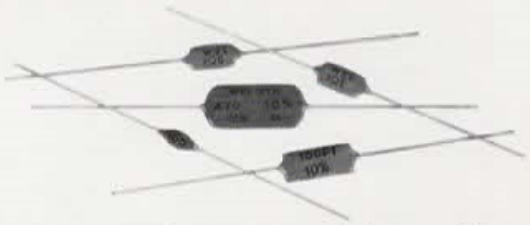
Working voltage . . . . . 350 volts D.C.

Insulation resistance at 20°C . . Not less than $10^{11}\Omega$ at 1000 volts D.C. The majority have an insulation resistance greater than $10^{12}\Omega$.

Power Factor at 1 Mc/s . . . . The average is better than 0·001.

Maximum ambient temperature 150°C.

Temperature coefficient of capacitance . . . . . The average value is approximately zero.



VITRICON capacitors incorporate entirely new principles in their construction which give some outstanding advantages in performance. Extensions to the range now offered, will be added in the future when the full capabilities of the technique are developed.

The vitreous dielectric is of special formulation having a high permittivity, low loss, and a coefficient of expansion matching that of the electrodes. This dielectric is fused and permanently bonded to the copper plates, giving great mechanical and electrical stability.

The terminals are of copper wire brazed to the plates, and the connection so made is capable of carrying heavy current. After cleaning, the wires are solder dipped, and this process provides eminently solderable terminals.

After the glazed plates are fitted together with the appropriate thickness of dielectric between them, the assembly is covered by a vitreous enamel. This protection is impervious to moisture, and ensures that the electrical properties are maintained even after prolonged exposure to tropical conditions.

Due to the simple form of construction of these capacitors, the inductance is very low, and the components may be usefully employed at high frequencies.

The components may be operated over a very wide range of temperatures, due to the fact that no organic materials are used in the construction. At 150°C, the insulation resistance is still maintained above 10^9 ohms, although the power factor may increase to the order of 0·003. The maximum ambient temperature should not be allowed to exceed 150°C.

The composition of the dielectric glaze is completely controlled, and therefore the electrical characteristics are consistently maintained. The composition can, however, be adjusted in order to give other specific values of temperature coefficient of capacitance. The dielectric used in the capacitors being manufactured at present, gives a temperature coefficient substantially zero, and having a spread of approximately ± 40 parts per million per degree Centigrade.

Further information will be published when the sizes of capacitors having different values of temperature coefficient are standardised.

MANUFACTURERS OF WELWYN ELECTRICAL COMPONENTS

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